Trauma System Consultation

State of Hawaii

Honolulu, Hawaii

October 23 –28, 2005

American College of Surgeons

Committee on Trauma

A multidisciplinary working group prepared this document based on the consultation visit that took place on October23-28, 2005 and included the following members:

Robert C. Mackersie, MD, FACS
Chair, COT Trauma System Evaluation and Planning Committee
American College of Surgeons
Director of Trauma Services
San Francisco General Hospital
San Francisco, CA

Christoph R. Kaufmann, MD, FACS
Associate Medical Director, Trauma Services
Legacy Emanuel Hospital
Portland, OR

Jon R. Krohmer, MD, FACEP
ACEP Liaison to ACSCOT
EMS/Trauma Systems Consultant
Grand Rapids, MI

Ms. Margaret E. Trimble
Retired Director of the Emergency Medical Services Office
Pennsylvania Department of Health
Harrisburg, PA

Nels D. Sanddal, MS, REMT-B
Technical Advisor TSC
President, Critical Illness and Trauma Foundation
Bozeman, MT

Observers:

Reginald A. Burton, MD, FACS
Trauma Director, Chair of the Division of Trauma
Surgical Critical Care Director
BryanLGH Medical Center
Lincoln, NE

Shelly D. Timmons, MD, FACS
Neurological Surgeon
Semmes-Murphey Clinic
Memphis, TN

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State of Hawaii

Emergency Medical Services & Injury Prevention System Branch

State of Hawaii Department of Health

Methodology

The Office of Emergency Medical Services & Injury Prevention System Branch (EMSIPCS Branch) for the State of Hawaii requested this trauma system consultation, which was conducted under the auspices of the American College of Surgeons, Trauma System Consultation program (TSC). The multi-disciplinary Site Visit Team (SVT) consisted of: three trauma/general surgeons, one neurosurgeon, one emergency physician, a former State EMS director, and a rural trauma & prehospital specialist. Biographical sketches for team members are included as Appendix A of this report.

Prior to the visit, the SVT reviewed the ACS Pre-Review Questionnaire (PRQ) completed by the office of EMS. The format of this report correlates with the components outlined in the ACS *Trauma Systems Consultation* document. The SVT also reviewed a number of related supporting documents provided by the EMS office.

The SVT convened in Honolulu Hawaii on October 23, 2005, to review the state of Hawaii Trauma System. In addition to the island of Oahu, the SVT spent one day each on the islands of Maui and the Big Island of Hawaii. The meetings during the five-day visit consisted mostly of plenary sessions during which the SVT engaged in interactive dialogue with a broad range of representative trauma system participants. There was also an opportunity for informal discussion with the participants, and time devoted to questions and answers. The SVT was unable to travel to Kauai, but met as a small group with trauma system participants from that island.

On October 28th, a final plenary session was held with system stakeholders invited by the lead agency during which a summary statement of principal findings by the SVT was presented. At this session, the elements and structure of an "inclusive trauma care system" were outlined, as well as the magnitude of the injury problem in the state of Hawaii. The major strengths, challenges, opportunities, and key recommendations made by the SVT were reviewed. A list of

participants that were involved in the discussions and deliberations is included as Appendix B of this report.

During the survey, the SVT met in sequestered sessions for more detailed reviews and discussion, and for the purpose of developing a team consensus on the various issues and recommendations involved in the survey. During the last two days of the visit, SVT wrote and revised a report of their findings and recommendations regarding the trauma system in the State of Hawaii. This report was based on the information contained in the PRQ, information obtained during the interactive dialogue, and information obtained in the course of informal interviews during the site visit. The factual information contained in this report has been thoroughly reviewed and corrected to the extent possible. Occasional minor inconsistencies related to the communication and transcription of information passed on to the surveyors during the interactive sessions will not affect the assessment and key recommendations made in the report.

The process by which this report was developed was independent of any other trauma system consultations or assessments. The State of Hawaii EMSIPCS Branch staff were given the opportunity to review this report for factual content, and the report has been subsequently reviewed, revised and edited by members of the ACS Trauma Systems Planning & Evaluation Committee.

Overview

The primary objective of this ACS trauma systems consultation is to guide and help promote a sustainable effort in the graduated development of an inclusive system of trauma care for the state of Hawaii. Hawaii is the 42nd most populous state in the country with a population of approximately 1.26 million spread over a total area of roughly 6,423 square miles, disbursed over a 1,523-mile range. This population density gives Hawaii the 13th highest population density in the U.S. The islands are geographically isolated, with the main population mass approximately 2,400 miles distant from the nearest major US city. This extreme isolation and limited re-supply capability renders Hawaii uniquely vulnerable to natural disasters that may occur in a mid-pacific environment.

County	Population increase
Honolulu	17.9 %
Kauai	58.5 %
Hawaii	77.0 %
Maui	95.1 %

Table 1: Population growth, by county, 1990 – 2004
Reference: U.S. Census

Hawaii has experienced a cumulative population growth rate of 4.2% since 2000, roughly matching that of the continental United States. The population growth within the islands has been disproportionate, with the highest growth rates seen on the neighbor islands (Table 1). These islands have also seen substantial growth in up-market real estate in the form of hotels/resorts, condominiums, and second/retirement homes. With this increased growth has, or will likely come, the expectations of enhanced public services, including trauma and emergency care, commensurate with the level and sophistication of these residential and resort developments.

Injury in the state of Hawaii accounts for 50.7% of deaths for persons with ages from 1-44, roughly one third more than that of cancer and heart disease combined (Figure 1). Data provided through the State Injury Prevention & Control Section indicates that motor vehicle traffic crashes were the predominant cause of unintentional death. The rates of unintentional injury on the neighbor islands were more than double those for Honolulu County across most age categories based on a report of fatal injuries in the state from 1996-2000. While possibly a function of several factors, this large disparity in the mortality rate from trauma suggests an association between delayed access to organized, definitive trauma care and risk of death in areas outside Oahu. These data underscore the seriousness of traumatic injury as a public health problem in the state. They also provide a strong argument for a concerted public health effort to continue the development of an inclusive trauma system that will serve the needs of residents and visitors to the state, particularly on the islands of Maui, Hawaii, and Kauai.

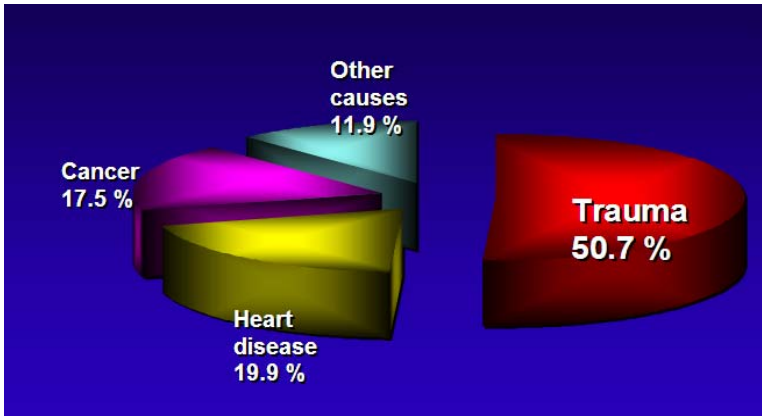


Figure 1: Cause of death, State of Hawaii, age 1-44 years

Current Status

Past efforts toward trauma systems development include a National Highway Traffic Safety Administration (NHTSA) assessment in 1991 which recommended:

- Amend current EMS legislation to include the following:
    - Trauma care system – authority for designation, mandatory trauma registry participation by all acute care hospitals caring for the injured, and triage protocols;
    - Certification of First Responders;
    - Formal recognition of County EMS Councils and delineation of roles and responsibilities (e.g. planning, coordination, and evaluation to address local needs); and
    - Liability protection – revise, if necessary, to address concerns.

- Amend current Administrative Rules regarding ambulance service licensure enforcement to provide specific authority for immediate on-site citation and/or temporary suspension in significant cases of failure to comply with requirements when non-compliance could result in compromise of patient care.

- In the course of developing and approving the state EMS strategic plan, review for compliance with functions outlined in Hawaii Revised Statute, seek early input from County EMS Councils, review EMS Branch staffing and Advisory Committee standing committee structure with the aim of supporting goals and objectives of the plan.

- Allocate sufficient resources to the State EMS Advisory Committee to enable them to travel to other islands as needed.

- Provide funding to support county EMS infrastructures (e.g. Council staffing, coordination).

In 1992, as part of the HRSA Trauma/EMS program, initiatives were begun to develop a state trauma plan and collect statewide trauma-related data. The plan was developed in 1993 through the EMSIPCS Branch, but was limited to guidelines for prehospital trauma triage. Inter-island transportation, a significant and unique challenge in Hawaii, was addressed in a 1999 report to the 20th state Legislature which included a "Hawaii Aeromedical System Strategic Plan". In 2001, when the federal Trauma/EMS (Title XII) program was re-funded, the state of Hawaii initiatives included an update of the State trauma plan, the completion of a SWOT (strengths, weaknesses, opportunities, threats) analysis, and a disaster preparedness survey. In 2002, a federal Trauma/EMS grant was awarded for further development of the trauma care system plan, the establishment of a statewide trauma registry, and the establishment of a statewide stakeholder's committee to oversee system development.

Further planning for a trauma system occurred circa 2003 based on the SWOT analysis completed the year before, and included the identification of five essential elements for a statewide system and four principal goals: establishment of a trauma advisory council, the development of a trauma care system plan, the establishment of a statewide trauma registry, and the development of sustained funding for trauma systems development. A trauma stakeholders group was formed in 2003 and efforts made to begin the development of a more comprehensive system of trauma care for the state, outlined in a document titled "A Trauma System for Hawaii". The activities of this group have not been sustained, and limited progress has been made on a trauma system plan or system-wide trauma registry.

Progress in trauma system development in Hawaii has been slow and inconsistent. Factors contributing to this include intermittent federal funding, limited state and municipal funding, the lack of sustained physician leadership, limited participation in trauma system development by physicians, institutions and municipal agencies at the island/regional level, and the lack of a centralized and appropriately staffed trauma system oversight structure with the authority to implement system improvements. In addition, the existence of a more centralized population well served by the single designated trauma center has resulted in little impetus for change.

The environment itself has now changed, and there is now additional federal funding available, including that related to the enhancement of disaster preparedness (bioterrorism funding), which has served to stimulate renewed interest in further trauma system development. In addition, there appears to be increased recognition that with the decentralized population growth in Hawaii there is a greater need to enhance the essential public services, including the provision of organized trauma care, in more remote areas. The decision to seek an American College of Surgeons, Trauma System Consultation is an important step, and is felt to be confirmation of the commitment to create an inclusive trauma care system for the state of Hawaii. The ACS site visit team acknowledges this commitment, and wishes to commend the Department of Health (DOH) and encourage them in their efforts to achieve this goal.

The current trauma system in Hawaii exists mostly as independently operating components and revolves around a single large Level II designated center, Queen's Medical Center, in Honolulu. Currently verified by the American College of Surgeons, Committee on Trauma as a Level II Trauma Center, Queen's Medical Center provides care for the vast majority of trauma on Oahu, pediatric and adult, as well as more serious trauma transferred in from the neighbor islands. There are no designated trauma centers on any of the neighbor islands, and only a single practicing neurosurgeon on Maui other than those on Oahu. The rapid transport of more severely injured patients to Queen's Medical Center is often problematic due to limited air medical transportation resources relative to the increasing demands on the transportation system. Physician availability for the care of trauma patients is lacking or inconsistent in some areas in the state and for some specialties (e.g. orthopedics, neurosurgery), increasing the demand for inter-facility transfer, and potentially placing additional burdens on the trauma center at Queen's Medical Center.

In terms of providing oversight and guidance to the Hawaii trauma system, Queen's Medical Center has a functioning trauma performance improvement (PI) program for its acute care facility, and the Hawaii EMSIPCS Branch has a well defined quality management plan, but the integration of these activities into a system-wide process for the review and improvement of trauma care is limited. There is currently no formal state Trauma Advisory Committee or other group charged with the responsibility for trauma system-wide performance improvement or system development.

There is an excellent statewide injury prevention program, but the integration of this program with the injury control initiatives involving the other components of the trauma system is not well developed. At the time of the system survey, there were vacancies in two key positions: the Queen's trauma medical director position and the state EMSIPCS director. There is currently no position or specific responsibilities for a system-wide trauma program manager.

The American College of Surgeons, through the Committee on Trauma, shares Hawaii's goal of promoting the delivery of optimal trauma care through the development of an inclusive trauma system. The primary objective of this trauma system survey is to work collaboratively with trauma system stakeholders to identify opportunities and actions that will help accomplish this goal. The following report is designed as an instrument to help identify and facilitate trauma system improvements.

ACS TRAUMA SYSTEM CONSULTATION: SUMMARY

Resources, Advantages & Assets

- Excellent injury prevention, across all age groups
- Mature, statutorily enabled and funded state EMS system
- Committed, high volume ACS-verified Level II trauma center in Honolulu
- Growth, development, & individual provider commitment in some areas
- Expanding tax base with real estate development & growth and the potential to help fund trauma system improvements at the state or municipal level
- Centralized billing model for ground ambulance services
- Electronic prehospital data collection

Challenges

- Extreme geographic isolation with limited access and re-supply capacity
- Geographic and operational barriers to intra-system transport and transfer
- Lack of sustained staffing & leadership (medical & administrative) to sustain trauma system development
- Variable physician commitment, recruitment, and retention for the provision of trauma care
- "Compartmentalization" of functions of system (common to most systems)
- Lack of strong linkage between clinical and administrative components of system
- Limited public and legislative appreciation of the essential public service aspect of trauma care and recognition of trauma as a public health priority

Current Opportunities

- Challenges that have stretched the capacity of Hawaii's only verified trauma center have created legislative interest in the trauma system.
- The recent retirement of leadership at the EMSIPCS Branch creates an opportunity to tailor the job description and requirements for that position to include leadership in trauma system development.
- The current economic status of Hawaii's State Government creates an opportunity to support the implementation of a comprehensive, inclusive, statewide trauma system plan.
- The state of Hawaii has a very strong emergency management / civil defense program throughout the state that could, potentially, provide resources to the trauma system development activities.

Key Recommendations:

The following are the key recommendations from each component of the trauma system. This is a summary only, and does not include all the recommendations or explanatory language which may be found in the body of the report.

Administrative

- Assess the needs and organization of the state EMSIPCS Branch to assure that the office has the staff and resources to meet the expectations and requirements defined in the statute and plans, including a position with specific responsibilities for the development of a comprehensive statewide trauma system.

- Formalize the trauma stakeholders group making it the State Trauma Advisory Committee (STAC) and link it with the state EMS Advisory Committee.

- Conduct a "Development of a Trauma System" Course (DOTS) for key leaders and trauma advisory stakeholders to establish a common vision and strategic goals. Use this to facilitate the development of the comprehensive trauma system plan.

- Create a comprehensive and inclusive Hawaii Trauma System Plan.

- Establish County Trauma Audit Committees (CTACs) for the counties of Hawaii, Maui, Honolulu, and Kauai that meets at least quarterly to address system issues and to coordinate trauma system improvement.

- Produce a comprehensive funding proposal, including budget justification, for trauma system development.

- Include county authorities in trauma system planning to explore partnership with the state lead agency for planning and policy development.

- Explore opportunities for additional trauma system funding by examining funding practices in other states/regions.

- Update the EMS statute and regulations to include clear language regarding trauma system development, administration and representation on the State EMS Advisory Committee, and to establish County Trauma Audit Committees (CTAC).

- Ensure that existing statutes/regulations and policies for hospital licensure, rehabilitation services, and other health care systems support trauma system development.

Human Resources

- Perform a needs assessment and implement strategic planning for trauma-related human resources.
- Improve access to enrollment for paramedic education programs.
- Develop mechanisms or programs to improve nurse and allied health personnel recruitment & retention.
- Create incentives and develop practice models to facilitate trauma-related physician recruitment and retention.

Definitive care, interfacility transfer

- Upgrade, verify, and designate Queen's Medical Center as a Level I Trauma Center.
- Organize the trauma resources in the State into an Inclusive Trauma Care System.
- Develop a backup trauma care capacity plan for Oahu.
- Resolve deficiencies in pediatric trauma care.
- Develop Maui Memorial Medical Center as a designated and verified as a Level III trauma center initially with a plan to evolve to a Level II facility within the next 5-10 years.
- Verify and designate at least one Level III trauma center(s) on the Big Island.
- Resolve the lack of neurosurgery coverage across the islands.
- Designate a trauma center on Kauai.
- Develop formal, codified transfer guidelines and agreements.
- Develop contingency plans for the anticipated elimination of MAST program.
- Analyze and improve current air medical transport system.

Injury prevention & control

- Expand the scope of the Injury Prevention and Control Section of the Emergency Medical Services and Injury Prevention System Branch to include the "control" attributes

of tertiary injury prevention, specifically the development, implementation and ongoing improvement of an inclusive and integrated trauma care system.

EMS management, prehospital transport, communications

- Recruit and employ the new state EMS Director as soon as possible. Charge that individual to aggressively pursue trauma system development goals.
- Provide for prehospital peer review protection from discovery for quality improvement activities through appropriate mechanisms within the state (e.g. legislation or rules/regulations).
- Enhance air medical transport resources throughout the state.
- Establish interoperable communications mechanism in all areas of the state allowing for routine and disaster related communications among all EMS agencies, other public safety agencies, hospitals, and emergency management (civil defense).

Disaster preparedness

- Continue the strong interface and cooperative interaction with civil defense / emergency management utilizing an all hazards approach for addressing the public health and health care needs for response to man-made and natural disasters.
- Continue planning activities with the CDC and HRSA Domestic preparedness programs.

Information systems

- Establish a formal statewide trauma registry incorporating all hospitals in the state.
- Ensure timely implementation of EMS electronic data collection throughout the state.

System Evaluation

- Appoint & convene a State Trauma Advisory Committee (STAC), under the aegis of the EMS & Injury Prevention System Branch, whose charge includes the development a comprehensive, system-wide trauma performance improvement (PI) plan.

- Develop a system-wide plan for trauma performance improvement (PI) plan, including indicators relevant to the specific problems faced by the state of Hawaii (e.g. time-to-definitive care), and a process whereby ongoing trauma PI system monitoring can occur.

Research

- Develop a working relationship between trauma clinicians, the EMSIPCS Branch and the University of Hawaii, to enhance trauma system research efforts.

Administrative Components

Leadership

Purpose

There should be a trauma system lead agency with an identified key person. The lead agency will usually be a government agency with the authority, responsibility, and resources to lead the development, operations, and evaluation of the trauma system. The statutes, regulations, policies, or guidelines should direct that the lead agency will:

- *Ensure the integration of the EMS system, including all prehospital components*
- *Coordinate system design*
- *Establish minimum standards for system performance and patient care*
- *Create a Trauma System Advisory Committee that is composed of prehospital personnel, hospital personnel, rehabilitation personnel, payors, consumers, and public interest groups. This committee should serve to guide system planning activities, define system criteria (number of centers, volume), recommend system standards (triage, timelines), and review system performance*
- *Have sufficient staffing, including a trauma system coordinator experienced in trauma system development and implementation*
- *Identify the key person in the lead agency*

The trauma system should have a strong role for a trauma physician(s) as an integral part of its leadership component. This physician, who will be the Trauma Medical Director, should be qualified to participate in the planning of the trauma system, work with the lead agency, be incorporated into the system, and be responsible for design and implementation of the trauma system, medical accountability, and ensuring an appropriate medical response to the trauma patient.

CURRENT STATUS

Hawaii has a mature, statutorily enabled and funded EMS system that includes injury prevention and control. The EMSIPCS Branch within the Department of Health is the lead for the state EMS system. The EMSIPCS Branch director, who recently retired, provided consistent leadership for the development of the system from 1978 until mid-2005. Under her leadership over the past 27 years, significant progress has been made in EMS system development. Highlights of these accomplishments include assuring a reliable, well-trained EMS responder cadre; establishing a significant injury prevention and control program; successfully securing federal grant funding for EMS for Children, emergency preparedness and other special projects.

A State EMS Advisory Committee is established in statute and has been in place since the late 1970's. The committee meets quarterly and composition is defined by statute. No county level officials are included in this composition. The Injury Prevention Advisory Committee is not linked with the State EMS Advisory Committee. No State Trauma Advisory Committee (STAC) exists.

Several of the neighboring islands have local EMS advisory committees. In Maui, the official committee is not active but an ad hoc grassroots assembly of interested constituents has been very effective in securing air medical rotary wing support for intra-island response. The island of Hawaii's EMS system is overseen by the Fire Commission and does not include representation from hospitals or other health care resources.

Presently, the EMSIPCS Branch has the following FTE positions identified: 1 director, 1 full-time medical director, 2 EMS Program Specialists, 5 Injury Prevention and Control staff and 2 billing clerks. The EMSIPCS Branch Director and Medical Director's positions are currently vacant. The Deputy Director, Health Resources Administration is acting as the director until the position is filled. The updated position description requires that the candidate for the director position be a physician. None of the current or proposed position descriptions include the specific responsibilities of ensuring the development of a comprehensive, inclusive statewide trauma system.

The EMSIPCS Branch is responsible for injury prevention and ambulance billing. The resources for injury prevention and control are adequate. The billing process has been outsourced and is reported to be very effective, resulting in increasing revenue from reimbursement from third party payors for ground ambulance services. With a new electronic prehospital data collection system to be implemented in 2006, billing will become even more streamlined, perhaps creating an opportunity to use the billing clerk positions for other program support.

In stark contrast to the adequacy of staffing for injury prevention and billing, the two positions for EMS system program are not adequate to perform the work of a lead agency for EMS. The work includes credentialing of all practitioners, inspection of ambulances, system evaluation, training and education, budget management, regional/district operations on neighboring islands. This work may require several more positions just to meet the statutory requirements. The

proposed trauma system development tasks identified in this report are significant and should be considered above and beyond existing statutory commitments. It cannot be accomplished with the EMS Branch structured and staffed, as it presently exists.

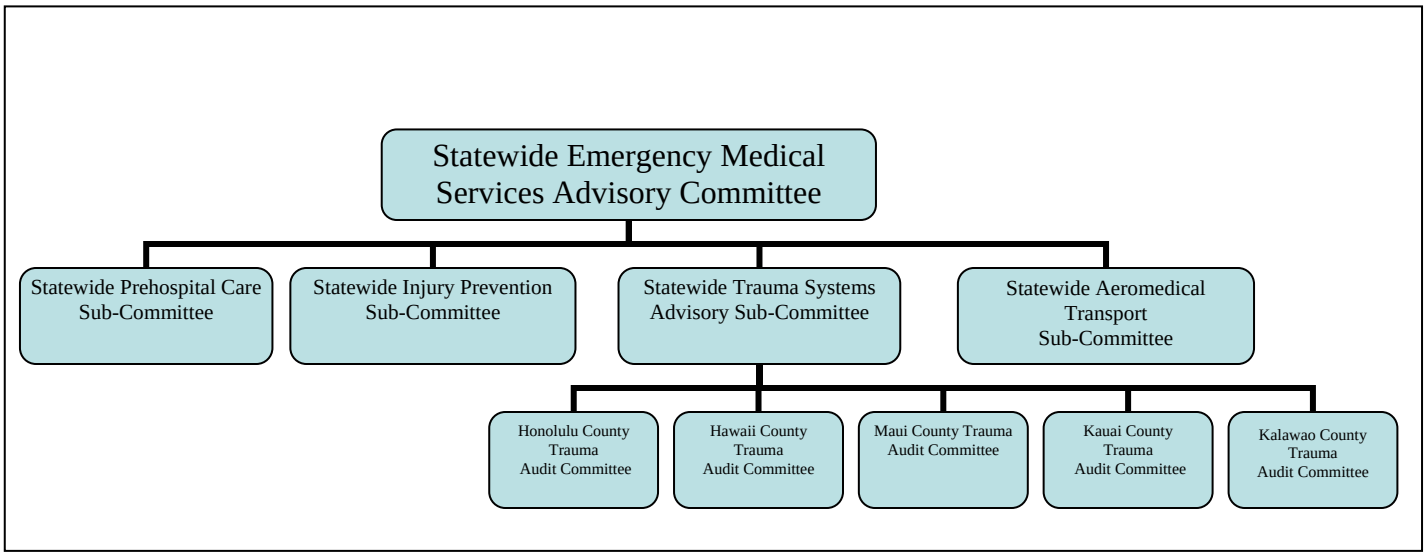
The 1978 statute establishing the EMS system also provided the authority to establish and administer a state trauma system, i.e., designate trauma centers, collect data and evaluate the system. However, Hawaii's trauma system development has been largely based on individual facility commitments. The exception is in the prehospital trauma triage protocols and transportation guidelines. Although the statute permits trauma center designation, only one center is designated. Trauma patients are being transferred to this designated trauma center from all of the islands. Specialty care for burn patients and some pediatric patients is available and delivered in two other hospitals. Many dedicated practitioners and administrators are providing trauma care but there is no lead trauma agency officially designated at any level. Clearly designated leadership is needed to define and then implement a trauma system plan.

There is no statewide trauma system registry; therefore, the lead agency is not able to use complete and reliable date to guide decision-making. The hospital emergency department data are collected and available to the EMSIPCS Branch along with the trauma registry data from one trauma center. Hospitals are licensed by the Department of Health but trauma system participation requirements, including data submission, are not included in licensure criteria.

In 2001, federal grant funding from the HRSA Trauma/EMS Office renewed interest in the trauma system development. During 2003, a stakeholders group met twice to begin trauma system development. A strengths, weaknesses, opportunities and threat (SWOT) analysis was accomplished. Numerous assessments had been done prior to this. A National Highway Traffic Safety Administration assessment in 1991 and a local aeromedical resource assessment in 1998 pointed out many needs and issues that remain unresolved today. The resolution of gaps in leadership and other challenges cannot occur without adequate resources being directed to the lead agency to support the effort. Designating a specific staff member to manage the trauma system plan development and implementation is necessary considering the extent of the work and the complexity of the challenges. A new EMSIPCS director with adequate staffing and support from the Department leadership will be critical to successful trauma system development.

The trauma stakeholders group that was formed as part of the HRSA Trauma System Grant process has not met since 2003. This stakeholders group should be formally constituted as a State Trauma Advisory Committee (STAC). The new committee could be organizationally tied to the present State EMS Advisory Committee. Leadership at the county levels is equally important. The formation of County Trauma Audit Committees (CTACs) for trauma system review and performance improvement would structure and focus the local trauma system participation. Figure 2 provides a visual representation of the relationship between the various committees

Figure 2: Suggested Organizational Chart



RECOMMENDATIONS

- **Assess the needs and organization of the state EMSIPCS Branch to assure that the office has the staff and resources to meet the expectations and requirements defined in the statute and plans, including a position with specific responsibilities for the development of a comprehensive statewide trauma system.**
    - Recruit a new State EMS Director as soon as possible who has an understanding of and is capable of leading the trauma system. Modify the present position description to include responsibilities for overseeing the state trauma system.
    - Recruit a state EMS medical director.
    - Designate a lead state trauma system medical director who will work through the state medical director and EMSIPCS Branch/Department of Health.
    - Develop a new position titled Trauma System Program Manager (or similar), under the EMS Director, charged with overseeing the development and execution of the Hawaii Trauma Plan, trauma system PI, and coordinating with other entities to develop the trauma system.
    - Establish county/regional EMS Branch staff positions sufficient to support system development and operation at the county level.

- **Formalize the trauma stakeholders group making it the State Trauma Advisory Committee (STAC) and link it with the state EMS Advisory Committee.** The STAC would be responsible for advising the EMSIPCS Branch in areas of regulatory

development, identification and resolution of key issues, and monitoring of system performance.

- **Create the Hawaii Trauma System Plan.**
    - Define a timeline for progress towards establishing a trauma system with clear milestones and dates.
    - Use the STAC executive committee as the oversight committee.
    - Provide this committee with a report of progress towards milestones, copied to the Deputy Secretary and the Secretary of Health, at no less than quarterly intervals.

System Development

Purpose

The trauma system lead agency should have a defined planning process for trauma system development that addresses:

- *Identifying trauma care resources, including resource deficits within the defined area of the trauma system*
- *Developing and implementing trauma care plans and systematically reviewing plans over time*
- *Including health professionals, consumer groups, and payors in trauma system planning*
- *Approving the trauma system plan*
- *Establishing, reviewing, and revising trauma system standards of care, including policies, procedures, and protocols for both the prehospital and hospital personnel*
- *Analyzing the financial impact of developing and implementing the trauma system.*

The trauma system should be integrated with the EMS system and should include a mechanism to interface with and incorporate other EMS plans, such as disaster and mass casualty. It should also have a mechanism to integrate managed care entities in the area.

CURRENT STATUS

Through a federal grant in 2001, the state re-energized efforts to establish a trauma system by completing the Federal assessment, “Survey of State and Local Efforts to Coordinate Trauma Care Delivery” and the “Disaster Preparedness Survey.” With the leadership from the EMSIPCS Branch, a State "Strengths, Weaknesses, Opportunities and Threats" assessment was done. Funding from the 2002 grant was provided to the state to organize a state-wide stakeholders committee to oversee system development, to finalize the trauma care system plan, to establish a mandatory state-wide trauma registry, and for securing funding for continuation of trauma systems planning, development and evaluation. Very few of these goals were accomplished. A trauma registry has been started based at Queen's Medical Center but only that facility

contributes data to it. The momentum generated from the grant did not continue and the statewide trauma plan does not yet exist. Additional state grant applications to the HRSA Trauma and EMS Program have not been submitted by Hawaii. No meeting of the stakeholders has occurred since 2003. The statewide trauma plan was not completed.

Some guidelines for the prehospital caregivers do exist. These include the trauma triage protocol and transport guidelines. They need to be updated for trauma care and adjusted for system changes and resource constraints, e.g., statewide "treat and refer" protocol, triage criteria for trauma transport to trauma centers.

The centralized referring system of patient to Queen's Medical Center previously billed as "one call does it all" is no longer in place. Practitioners spoke highly of the effectiveness of the previous process and would like to have it available again. The absence of the central referring and transport dispatch center is creating significant transaction costs for patients and practitioners. Anecdotal reports suggest that significant delays in patient transfers into the trauma center are occurring part due to delays attributed to the numerous calls needed to facilitate transport arrangements.

Limited leadership has been provided in the area of trauma system development by the EMSIPCS Branch. This absence of effective leadership, funding and manpower constraints contribute to deficiencies across the current trauma system. Some grassroots efforts and leaders have addressed special interest issues, e.g., the 1998 report on aeromedical needs, the Maui ad hoc group securing intra-island aeromedical support, and Queen's Medical Center securing a legislative order for specialty care physician problem assessment. There is a stated interest between and among various stakeholders in trauma system development.

The EMS system has established working relationships between the prehospital practitioners and the base stations. The local EMS system is integrated with the acute hospital system and with the hospital emergency preparedness process to varying degrees. The Emergency Preparedness staff, who are funded by the HRSA grant, are employees of the Healthcare Association of Hawaii (HAH). These new positions are tasked with improving the overall health care system's emergency preparedness and response capabilities in Hawaii and are working to increase the coordination between traditional health care facilities and prehospital care. The staff works closely with the Department of Health. The integration with other emergency preparedness and response agencies such as Civil Defense and the HI Army National Guard is limited.

Consumer participation in the system is evident within the injury prevention efforts, especially for the projects directed at children, and the ad hoc effort on Maui that resulted in aeromedical response for that county. However, consumer participation is largely untapped for trauma system support and development. County-state coordination and collaboration for state trauma system development is minimal. The review of trauma cases varies from county to county and trending is not documented or reported to the state EMS Branch. The absence of these data is seen as a deficiency that should be corrected to support ongoing trauma system development and improvement.

Fragmentation of the system was evident from discussions and questions generated at meetings between the ACS SVT and various stakeholders on each of islands. Solutions to challenges are often seen as the Department of Health's issue to resolve. In some cases, resources, i.e., neurosurgeons, air ambulances, pilots, critical care nurses for medevac transport, exist but the affiliations (agency, independent practice, etc.) create barriers to marshalling these resources in a way that might permit meeting needs with existing resources.

Hawaii, with the leadership of an adequately staffed EMSIPCS Branch and led by a director who is experienced with trauma system development, has the necessary information to formulate an inclusive statewide trauma system plan. However, all leaders and key agency representatives must share the same understanding of a comprehensive and inclusive trauma system.

RECOMMENDATIONS

- **Conduct a "Development of a Trauma System" course (DOTS) for key leaders and trauma advisory stakeholders to establish a common vision and strategic goals. Use this to facilitate the development of the comprehensive trauma system plan.**

- Implement a consistent, statewide process for establishing, reviewing, and revising trauma system standards of care, including policies, procedures, and protocols for both the prehospital and hospital personnel. As a priority, assess trauma-related patient care protocols and transport destination guidelines to include "treat and refer" so that scarce resources of ambulances, air ambulance, hospital capacity and specialty care (trauma) are more available for time-critical patients'. This could be incorporated into the activities of the State Trauma Advisory Committee (STAC).

- **Establish a County Trauma Audit Committee (CTAC) for the counties of Hawaii, Maui, Honolulu, and Kauai that meets at least quarterly to address system issues and to coordinate trauma system improvement.**

    - Assure that the CTAC includes representatives and members from each system component, i.e., hospitals, clinics, EMS, fire, National Guard and other military organizations, injury prevention, Civil Defense and consumers. Support each CTAC with a region-based EMS Branch employee. Include planners from the state health improvement projects.

    - Identify and designate a local trauma medical leader to provide expert support and direction to the committee.

    - Provide each CTAC with a common charge that includes local system oversight and performance improvement activities.

    - Conduct a county specific trauma system assessment using this Trauma System Consultation report and the "Model Trauma System Planning and Evaluation –

Benchmarks, Indicators, and Scoring for State Trauma System Self-Assessment." Incorporate information from prior assessments that were done for the 2001 Trauma System Development grant and the emergency preparedness grants.

Legislation

Purpose

- *Comprehensive legislation is essential for trauma system development. The creation of statutes and regulations to develop the trauma system sets in place the necessary legal authority to move forward without concerns about anti-trust issues. Comprehensive statutes and regulations can provide for the process of planning, implementing, and funding the trauma system. Key provisions in trauma legislation include the ability to work through constituency groups to:*

- *Develop a comprehensive trauma system plan*

- *Integrate the trauma program with the existing EMS system*

- *Incorporate prevention programs and activities*

- *Establish or adopt guidelines for the prehospital, acute hospital, and the rehabilitation phases of trauma care*

- *Collect data and evaluate system performance*

- *Provide for confidentiality of trauma records, reports, and quality of care reviews*

- *Establish authority to designate trauma centers*

- *Provide authority for the inter-/intrastate and international planning and implementation of trauma systems, without regard to jurisdictional boundaries.*

Additionally, trauma legislation should include a dedicated funding mechanism and an administrative structure for trauma management and should ensure fiscal support for all components of the system, including the legal authority to ensure that third-party payment is coordinated within the trauma system.

CURRENT STATUS

The statutory authority for developing and administering a state EMS system has existed since 1978. Since that time, the statute was amended in 1981, 1993 and 1994. Current EMS system regulations authorized by the statute support the implementation of Hawaii's EMS system. Presently, two levels of practitioners are authorized, the Emergency Medical Technician (EMT-Basic) and the Mobile Intensive Care Technician (EMT-Paramedic). The state is authorized to contract for and bill for all ambulances services. A State Emergency Medical System Advisory Committee is established by statute; their members are defined specifically by statute. No trauma leader is designated as a member.

Although the EMS statute is not written with great detail addressing trauma system development, it does enable the Department of Health to designate trauma centers, collect data and evaluate the system both prior to admission and after admission to a hospital. Trauma centers and system are not specifically addressed in the regulations but transportation guidelines are authorized, as is a requirement to categorize emergency facilities. Protection from discovery for peer and interagency review of trauma patient care is not included in either the statute or regulations. Data collection is supported strongly in the legislation. No authorization for trauma center supplemental funding to cover uncompensated care exists in the statute.

Additional attention to the value of and concern about trauma care, particularly the "on-call crisis" at the one designated trauma center - Queen's Medical Center, was identified in 2005 through a House Concurrent Resolution (H.C.R. No. 229) which called for "the legislative reference bureau to coordinate studies, with the assistance of the Department of Health to evaluate the impact of the physician "on-call" crisis and to recommend any appropriate government and private sector responses to the on-call crisis to ensure continued access to trauma level care."

RECOMMENDATIONS

- **Update the EMS statute and regulations to include clear language regarding trauma system development, administration and representation on the state EMS advisory committee, and establish County Trauma Audit Committees** (CTAC)**.**
    - Include the authority to develop the statewide trauma system plan, integration of trauma and EMS systems, establishing or adoption of standards of care, anti-trust protection, designation and de-designation of trauma centers, organization of data collection and system evaluation, quality management and quality improvement programs, confidentiality of trauma records, reports, and quality of care reviews, prevention programs and activities.

- Modify the *Certificate of Need* legislation/requirement addressing this at the highest levels of the Department of Health and executive branch to address urgent system needs, e.g., remedy of the shortfall in air ambulance availability and supply.

- **Ensure that existing statutes/regulations and policies for hospital licensure, rehabilitation services, and other health care systems support trauma system development.**

- Evaluate the need for including additional levels of practitioners in the EMS statute, e.g., the inter-facility critical care transport personnel, emergency vehicle ambulance operators, EMT-B, EMT-Paramedic in place of Mobile Intensive Care Technician (MICT); updating fees in regulations; adding protection of peer review and system performance improvement; including medical base stations, medical directors and county/state advisory councils.

- Consider the amendment of the EMS Statute to include the integration of emergency air medical services as a component of the State Comprehensive Emergency Medical Services System with authority for the Department of Health to contract for services and bill third-party payers for reimbursement.

- Consider legislation for supplemental funding to the EMSIPSC Branch for trauma system development and to trauma centers and air medical transport providers to cover uncompensated care.

Finances

Purpose

Evaluating the health of a trauma system's finances is still in its early development stages. This section outlines generally accepted business financial principles that are used as baseline.

At all levels of evolution, the trauma system should demonstrate through its trauma system lead agency financial accountability. This accountability should first include lead agency reporting of financial stability. Second, the lead agency should show the development of routine financial reporting by component, which reflects the financial health of the system. Trauma system components include system management, prehospital, trauma facilities, acute care, rehabilitation, and prevention programs. The lead agency should have established the following processes:

Lead Agency Financial Accountability

- *A standardized model accounting report that lists costs and is used consistently with standardized definitions throughout the system*
- *A process to develop, review, approve, and monitor expenditures and revenues by line item*
- *A process to develop, review, approve, and monitor each component's costs over time*
- *A process that allows the trauma system financial costs to reflect its relationship to the trauma plan outcome measures*
- *A process for maintaining at least two years of audited financial records that meet accepted financial accounting principles*
- *A process to audit the financial health of the trauma system over time*

Component Financial Accountability

- *A process that defines how trauma centers integrate alternative delivery systems (payor systems) into the trauma program*

- *A process that defines how rehabilitation centers integrate alternative delivery systems (payor systems) into the trauma program*

- *A process that defines the incremental component costs associated with trauma system participation*

Overall, the lead agency financial component should be integrated with other existing plans of the emergency medical service system to include, but not be limited to, disaster, prehospital, trauma facilities, acute care, rehabilitation, and prevention programs.

CURRENT STATUS

Hawaii is unique in the nation in that the state EMS Office bills third-party payers for ground ambulance transports and care. In 1991, $5.4 million were collected. Last year, $13-14 million was collected. This year, revenue collected for ambulance services billed by the state is expected to be $22 million. The revenue collected is deposited into the state general fund. While the collected amount falls short of covering all expenses associated with the system, the gap is closing rapidly. The air medical service, Hawaii Air (HA), bills independently. Reports from the HA indicate that from January to September 2005, reimbursement totaled about $540 thousand for patients covered by Quest. The number of uninsured patients transported during that same time period totaled 115, but this number included all categories, not exclusively trauma patients. Reimbursement information for the third-party payor patients (other than Quest) was not provided to the review team and is not included in this report.

The Department of Health expends approximately $33 million (and $2.8 million supplemental) to fund the contracts for prehospital care in the state which are awarded to two fire departments and one private ambulance contractor. Hawaii Air is not contracted for its services but operates separately from the process established for the rest of the EMS system.

In 2004, authorization for a fee of $5 on each auto registration was passed by the legislature to support the EMS system. The income from this source is placed into a special fund for the purpose of funding EMS system needs. The revenue collected in the first year of implementation was $4.6 million. None of these funds are specifically earmarked for trauma system development.

The trauma system has no dedicated state funding. Grant funds from federal sources include $40,000 in 2002, $35,000 in 2001 (for trauma system assessment and planning) and $148,217 for rural system development in 1992. Because hospitals have not been officially designated as trauma centers at any level, none are eligible for destination fee charges. The potential exists for this fee to be negotiated with third-party payers to cover the standby and readiness costs of the hospitals designated as trauma centers, regardless of level, within a defined system.

Recently, on-call pay for physician specialists, e.g., orthopedic surgeons, neurosurgeons, etc., has become an issue with the physicians and a financial challenge for the hospitals. At the time of this assessment, that issue has not been resolved fully. Queen's Medical Center reported spending $6.5 million and $6.9 million in stipends and on-call pay, respectively, this year for physician support to the trauma center. The CEO of Queen's Medical Center was quoted in a recent news article in 2005 as stating that the trauma program there cost the hospital $32 million and that the hospital lost $4.6 million annually. QMC currently has no method for recovering costs associated with the cost of readiness, idling costs or opportunity costs associated with being the only designated trauma center in the State of Hawaii.

The state EMS Office was funded $42,032,083 of General Funds, $5,230,000 Special Funds and $3,237,622 Federal Funds in FY 2005-06 (total $50,499,705) according to operating budget worksheets dated July 22, 2005. Federal funds were composed primarily of the Hospital and EMS Emergency Preparedness grants from HRSA and were used to fund hospital decontamination sets, personal protection equipment, and training and surge bed capability. For FY 2006-07, this program is now relocated and not part of the EMS Office structure or responsibility. Funds from this source are available to the trauma and EMS systems if the needs fit the requirements of the grant and if they are identified and included in the grant proposals.

For FY 2006-07, the Office is funded $42,032,213 of General Funds and, $2,600,000 of Special Funds. The federal grant allocation of $3,237,622, although shown in the budget under EMS Office, is now relocated and not part of the EMS Office budget. Using FY 2005-2006 funding amounts, the Deputy Secretary reported that funds allocated specifically to trauma and EMS totaled $2,290,000. This included grant funds from the EMS for Children grant which is not yet awarded in FY 2006-07.

Funding for physician salaries on Oahu, Hawaii, Maui, Kauai were combined to fund a full time temporary (to become a permanent position) Medical Director position for FY 06 and 07 budgets in the EMS Branch. The position is not filled at this time. Supplemental funding for Air Medical Services on Maui and for Poison Information Services was added in FY 06 and 07.

The fees charged for licensure of ambulance services and inspections of vehicles annually were established in the early 1980s. These funds are also returned to the General Fund. The fees identified in the EMS Statute should be reviewed and potentially, updated, as they do not include any cost adjustments, since they were established in the early 1980’s.

A trauma registry has been established that can track trauma patient charges but only one hospital contributes data to the registry so it is not a complete representation of the charges or of the costs of the trauma center or system. No other tracking mechanisms for trauma system costs are in place at this time. Without a true trauma system and a consistent, uniform accounting reporting process, it is not possible to equate costs to relative value gained (cost of utilizing resources). At this time, the state cannot combine and analyze the trauma system from an overall cost and benefit standpoint. Funding needs assessments have not been done; systems operations costs tracked cannot be tracked to provide historical data to justify new funding.

- **Produce a comprehensive funding proposal, including budget justification, for trauma system development.**
    - Use trauma registry, Hospital Association, Injury Prevention and Control, prehospital EMS and other data sources to identify costs of trauma care, rehabilitation and preventable deaths. Use census and other information sources to project future needs. (See *Financial Analysis of Florida's Trauma System, 2002).* Assure that the proposal is based upon reliable and complete data and that it includes funding resources in addition to the state general fund, e.g., special fees, special funds, reimbursement, matching funding, etc. Conduct a financial analysis for urgently needed air medical operations as a priority.

- **Include county authorities in trauma system planning to explore partnership with the state lead agency for planning and policy development.**
    - Educate county leaders about trauma system issues in their county and regularly provide them with county specific trauma related information so that county level operations complement state and other county trauma system development and maintenance.
    - Explore the allocation of some proportion of property development revenues to support trauma system development at county levels.

- **Explore opportunities for additional trauma system funding by examining funding practices in other states/regions.** (See chart from HRSA and the Arkansas state system information.)

- Support the EMS Office in applying for/being included in federal funding from emergency preparedness (CDC, HRSA and Department of Homeland Security), the Crash Outcome Data Evaluation Study (NHTSA) and HRSA's rural health system development program to fund the development of the EMS and trauma system.

- Implement budget reporting that includes a standardized model accounting report. Include the costs of the trauma system. Use standardized definitions and methodology throughout the state. Implement a process to develop, review, approve, and monitor expenditures and revenues by line item; a process to develop, review, approve, and monitor each component's costs over time; and a process that allows the trauma system financial costs to reflect its relationship to the trauma plan outcome measures.

- Review and update fees identified in the EMS Statute to reflect cost increase.

Operational and Clinical Components

Injury Prevention and Control

Purpose

A comprehensive injury control system includes prevention and rehabilitation in addition to acute care. The ultimate goal of an organized trauma care system is to prevent injuries, just as the ultimate goal of medicine is to prevent disease. Consequently, the trauma care system should participate in the establishment of a system-wide injury control coalition (SICC). One form is an IPC or injury prevention center. Composed of members from public and private sectors interested in prevention activities, this coalition will create prevention partnerships to reduce fragmentation and intensify community interventions.

- *Jointly with the SICC, a plan to promote injury control should be developed and implemented that will:*

    a) *Heighten awareness of injury as a public health problem*

    b) *Educate elected officials and the public about the need for trauma care systems and injury control to promote the passage and implementation of legislation aimed at reducing injury*

    c) *Educate the public about current trauma system development*

    d) *Educate the public about how to safely approach an injury scene, access the trauma care system, and provide assistance to the injured person until professional help arrives*

    e) *Involve public/voluntary organizations to aid system financing*

    f) *Conduct injury surveillance*

    g) *Develop a system-wide consensus approach to injury control interventions using needs assessment and intervention evaluation*

    Communicate key trauma prevention strategies.

- *The trauma care system should do a needs assessment to identify priority injury problems (including identification of high-risk groups and environmental factors)*

- *With the support of the trauma care system, the SICC should develop and implement priority injury control interventions that follow the injury control plan*

- *The SICC should carry out a public information program that follows the injury control plan*

- *The SICC should evaluate the success of injury control interventions. Outcome evaluations using trauma system data are preferable*

- *The SICC should integrate the potential of an organized entity to promote prevention activities within the system.*

CURRENT STATUS

The injury prevention and control activities represent one of the most mature aspects of Hawaii's current trauma system. The Injury Prevention and Control Section is administered within the EMSIPCS Branch. It is well staffed and includes an injury epidemiologist. In 1984, a task force was constituted to advise the Injury Prevention and Control Program. Both of these organizations have undergone an evolutionary transition and currently exist as the Injury Prevention and Control Section and the Injury Prevention Advisory Committee. The Injury Prevention and Control Section is directed, in an unofficial capacity, by a multi-disciplinary Injury Prevention Advisory Committee (IPAC) that is broadly representative of public and private interests. The IPAC roster lists 44 members, of which four are from islands other than Oahu.

The mission of the IPAC is:

> The IPAC seeks to increase community understanding of injury in order to reduce the number of injuries, injury-related deaths, and their immediate and long term effects in Hawaii. (IPAC, Status and Progress Review, 2003)

Statewide, county and community engagement in childhood injury prevention activities is supported through the Keiki Injury Prevention Coalition (KIPC). The involvement and leadership of KIPC was acknowledged by participants to be variable between islands.

The resources of these three groups, the Injury Prevention and Control Section, the IPAC and KIPC have been brought to bear on many important injury prevention activities. Impressively, the collective activities of this group are well documented in a variety of publications, including:

- Injury Prevention in Hawaii: Status and Progress Review

- Protecting Our Children: Strategies for Injury Prevention
- Protect Our Keiki: at Home, at Play and on the Way
- Hawaii Injury Prevention Plan 2005-2010
- Fatal Injuries in Hawaii: 1996-2000

These publications represent a sophisticated historical record of achievement. In particular the later two documents present a wealth of information that is a useful starting point for trauma system planning and development activities.

While much of the documentation is based on injury mortality, the staff of the IPCS is sophisticated enough to extrapolate data from hospital discharge and emergency department, and EMS data sets. This adds to the depth and breadth of the understanding of the injury epidemic and has helped to identify possible target populations and methods of intervention.

The IPCS underwent an independent external program review in 2003, conducted by the State and Territorial Injury Prevention Directors. The reviewers were quick to compliment the IPCS on many aspects of their program. They also suggested a number of areas of potential improvement that bear reinforcement in this report. Among others, those included:

- Develop and implement a plan to disseminate injury data to policymakers, and provide public education about injuries as a major public health problem to develop a stronger constituency for injury prevention.

- Work with EMS providers, hospitals, other health-related organizations and the Department of Education to promote injury prevention policies on neighbor islands.

- Identify other opportunities to implement regulations or policies to promote injury prevention.

Even though the Injury Prevention and Control Section of the Emergency Medical Services and Injury Prevention System Branch includes the term “and Control” in its title, to date, limited effort has been formally applied to controlling the effects of injury by ensuring the availability of a well-conceived and fully-integrated trauma care system. Such an inclusive system has the potential to significantly reduce death and disability from injury. The fact that the Injury Prevention and Control Section has a documented track record of planning, implementation, evaluation and reporting of various injury prevention initiatives may position it well to expand its focus to the “control” mission of its title which involves treatment of injured patients through an effective and inclusive trauma care system. This approach is very much in keeping with initiatives at the federal level described in the *Model Trauma System Planning and Evaluation: Trauma Systems Collaborating with Public Health for Improved Injury Outcomes* (2005) document.

> This model emphasizes a public health system approach to trauma system development. The system is inclusive, engaging not only health care facilities to the level of their

capabilities, but also the full range of public health services available in communities served. The overall goal is a collaboration of these two systems of health care [trauma care and public health] and related services to reduce the incidence and severity of injury, as well as to improve the outcomes for those who are injured. (p. 1).

RECOMMENDATIONS

- **Expand the scope of the Injury Prevention and Control Section of the Emergency Medical Services and Injury Prevention System Branch to include the "control" attributes of tertiary injury prevention, specifically the development, implementation and ongoing improvement of an inclusive and integrated trauma system.**

- Use incidence and morbidity data from the future system trauma registry and electronic prehospital data to further refine the overall injury prevention and control activities for the state of Hawaii and its counties.

- Constitute and formalize the Injury Prevention Advisory Committee (IPAC) as a formal sub-committee of the Emergency Medical Services Advisory Committee to ensure communication and collaboration with the Trauma Systems Advisory Sub-Committee. (See Figure 2)

- Continue and strengthen childhood injury prevention activities through private and public support of the Keiki Injury Prevention Coalition (KIPC), including the establishment or revitalization of KIPC chapters in Maui, Hawaii and Kauai counties.

Human Resources

Workforce Resources

Purpose

The trauma system should have a distinct process for evaluating the adequacy of human resources available (within and outside the hospitals) to support normal system activity. The process should:

- *Match resources with patient needs*
- *Define the optimal number and type of prehospital personnel and resources to be available to care for trauma patients*
- *Define the optimal number and type of hospital personnel and resources to be available to care for patients in all areas of the hospital*
- *periodic reevaluation of resources through an initial needs assessment and identification of trauma care work force resources and matching resources to patient care*
- *Determine a plan for dynamic flexible response for optimal management of patients during peak periods of activity that stress the system (both prehospital and hospital resources should be included in the plan)*
- *recruitment and retention of qualified personnel*
- *Identify current numbers of certified prehospital personnel and their level of certification*
- *Identify current hospital personnel resources, including physicians and their specialties, nurses, and other health care personnel*
- *Evaluate resources and personnel in trauma specialty care units for pediatric, burn, spinal cord, head injury, and rehabilitation centers*
- *Identify the number and severity of injured patients cared for by hospitals and individual surgeons*

- *Assess the impact of system operations on existing levels of professional resources within the community, including limited physician specialists, such as neurosurgeons, orthopedic surgeons, anesthesiologists, and so on*

- *Identify the number and severity of injured patients cared for by emergency physicians.*

CURRENT STATUS

While there was a workforce assessment completed in 1995, a recent and definitive needs assessment on the current status of prehospital providers, nurses, physicians (including subspecialists) is lacking. There is also not a strategic plan for recruitment and retention of EMS personnel, nurses, physicians and subspecialists on any of the islands. The site review team was told that workforce development appears to be "an afterthought".

The prehospital EMT and MICT workforce is adequate and fairly stable across the neighbor islands, although there are additional needs on Oahu. However, the availability of prehospital training programs lag behind demand, especially in the neighbor islands. For example, ten years ago there were 180 applicants on Maui for prehospital training, while for the most recent class there were only five. Existing EMT-B's reported waiting nearly a decade for MICT training to be available on Maui, effectively eliminating career advancement opportunities and reported contributing to career changes for some personnel.

There is a definite deficit in nursing personnel as illustrated by the fact that Maui Memorial Medical Center currently employs 57 "traveler" nurses and Hilo Medical Center employs an additional 25 "travelers". The extent of the shortage across various nursing focus areas such as emergency department, surgery and ICU is unknown.

The physician workforce appears to be adequate in breadth and depth only on Oahu. Some subspecialties are particularly in short supply. As an example, outside of Honolulu County, there is only one neurosurgeon in the state. Again, without a comprehensive workforce assessment, the SVT could not ascertain the details of the physician shortage by island or subspecialty.

Physician malpractice concerns have resulted in some surgeons removing themselves from the trauma call panel at Queen's Medical Center, in part because of the "pro se" litigious environment in the state. Problems of on call pay for orthopedic surgeons and other specialists were noted as problematic for both neighbor island hospitals (e.g. MMMC) and the designated trauma center (QMC).

- **Perform a needs assessment and implement strategic planning for trauma-related human resources.**
    - An assessment of the current needs of prehospital, nursing, and physician workforces on all of the islands should be performed. The needs assessment needs to address the issues of physicians that are not willing to work full time or take call at a reasonable frequency.
    - With knowledge of the extent of the need or problem, strategic planning can be performed. This plan needs to be developed and/or modified by the State Trauma Advisory Committee (STAC).
    - The workforce supply and attrition, as well as the number those in training (and their expected date of completion of training) should be continually monitored and the strategic plans updated to reflect any changes.

- **Improve access to enrollment for paramedic education.**
    - The apparent obstacles to enrolling in the paramedic (MICT) program at Kapiolani Community College (based on prerequisite course requirements for degree program eligibility) should be addressed at a statewide level to facilitate increased enrollment in the program.
    - One option is to provide the coursework to neighbor islands without conferring the degree. This would eliminate the need for the prerequisite courses. Initiating a reading aptitude test would screen out the applicants that could not read at the level needed for the course. The neighbor islands would have to accept passage of the National Registry of EMT's as requirements for employment rather than a degree.
    - Another option would be to permit certain individuals to take the college prerequisite courses concurrently during the first part of the MICT program.

- **Develop mechanisms or programs to improve nurse and allied health personnel recruitment & retention.**
    - Nursing and other hospital personnel find it difficult to move to the islands without affordable housing. Options should be explored that would provide this housing. With the amounts being spent on traveling nurses, and the shortages of other hospital employees, this may prove to be very financially feasible for the state, county, or hospitals.
    - Issues with nursing education in the islands should be aggressively pursued. Retaining professionals that are natives of Hawaii will always be easier than attracting and maintaining off islanders.

- **Create incentives and develop practice models to facilitate trauma-related physician recruitment and retention.**

- Develop appropriate incentives and practice models, both professional and financial, to ensure adequate recruitment and retention of physicians.
    - These may include providing clinic/office space for professionals; schedule a given space so that multiple physicians can use it on different days, and contracting with groups of physicians to ensure prolonged viability of a specialty.
- Affordable housing is part of the problem. Investigate options to provide housing for physicians of the quality that they would enjoy long-term. Consider innovative approaches such as contracting physicians for a ten or fifteen year employment commitment in exchange for ownership of a home.
- Make concerted efforts to break political walls that frustrate incoming physicians. These would include issues such as modernizing practices and enabling capable physicians to improve the system.

- Focus prehospital recruitment on high school students.
    - Despite the prehospital work force being relatively stable across the entire island chain, the mean age of these providers is older than in many other states. Efforts to recruit additional prehospital providers may best be focused on high school students in order to get them interested in an EMS career at an early age.

Education

Purpose

The trauma system should have adequate education for all levels of trauma care personnel, both hospital and prehospital. The trauma plan should :

- *Standards for the credentials, educational preparation, certifications, and continuing education requirements (including injury prevention and control) for all personnel*
- *Incorporation of injury control information in educational standards for all trauma care personnel*
- *Quality management monitoring of courses and instructors*
- *Processes for state credentialing, certification, recertification, and decertification of trauma care personnel*
- *An organized needs assessment prior to developing new or additional educational activities.*

CURRENT STATUS

Trauma education for medical providers at all levels (prehospital, nursing and physician) may be more important for the citizens of the state of Hawaii than for any other state because of the extreme geographic isolation. The importance lies not only the total number of providers at all levels trained in the specific nuances of trauma care, but also the experience and expertise of these providers. While there are many methods to encourage providers to maintain trauma education certification, the most effective of these are requirements linked to credentialing and re-credentialing of providers and verification and re-verification of trauma care system member institutions. The latter approach requires full participation of all acute care facilities in an inclusive trauma system to achieve the desired effect.

Little data was provided to the site review team as regards trauma education for trauma care providers, particularly on the neighbor islands where there was incomplete representation from various provider groups during the site visits. Additionally, there is no trauma system plan which describes the trauma competencies and expectations for each provider group.

The limited information that was provided is listed below.

Prehospital Education

Prehospital providers at the EMT and MICT levels take PHTLS during KCC education and are required to recertify every 2 years. The EMT-B level is enhanced and requires 180 hours of didactic and 135 hours of clinical experience and is the functional equivalent of an (NHTSA NSC) EMT-Intermediate (1985). The MICT course is equivalent to many academically based EMT-Paramedic training programs on the mainland. Prehospital Trauma Life Support is required in the initial training of both EMT and MICT. Recurrent PHTLS certification is required.

Nursing Education

Little is known about the specific trauma training for nursing personnel. Emergency Department Nurses at Queen's Medical Center are certified in Trauma Nurse Core Curriculum or similar courses by virtue of their verification as a Level II Trauma Center by the ACS. The status of nursing personnel in other hospitals is unknown. Trauma training courses were noted to be commonly available on Oahu.

Physician Education

Some physicians have taken Advanced Trauma Life Support (ATLS) which is also noted to be commonly available on Oahu. Again, through the verification requirements of the ACS it is known that physicians at QMC receive trauma CME. Additionally, there is a multi-disciplinary trauma symposium sponsored by QMC on an annual basis.

RECOMMENDATIONS:

- The Queen's Medical Center trauma symposium should continue to be presented annually and should attempt to meet some of the trauma education needs of all trauma care providers.

- Teach trauma specialty courses in an adequate number for all personnel in the state (PHTLS, PALS/APLS, TNCC/ATCN, FCCS, ATLS). Offer these courses in the neighbor islands to maximize distribution while minimizing travel expenses.

- Establish standards for trauma-related training & education as part of the overall trauma system plan.
    - Consider requiring appropriate current trauma course certification for all trauma care providers (PHTLS, PALS/APLS, TNCC/ATCN, FCCS, ATLS).
    - Consider provision of advanced courses for general surgeons on the neighbor islands, such as the Definitive Surgical Trauma Care Course (DSTC) or Advanced Trauma Operative Management Course (ATOM) and Fundamentals of Critical Care Course (FCCS).
    - The Rural Trauma Development Course should continue to be used to teach trauma teamwork in hospitals across the state.
    - Remove perceived barriers to EMT-B and EMT-P training on all islands.

Prehospital Care

Purpose

Emergency Medical Services Agency

Each system should identify an agency that is ultimately responsible for prehospital care.

The administration of this agency should include:

- *A medical director familiar with, experienced in, and currently involved in prehospital care*
- *A medical director whose qualifications are commensurate with his/her scope of responsibility in the EMS system*
- *Quality improvement education and monitoring functions performed by the medical director or designee*
- *Sufficient support staff, including a system administrator experienced in prehospital management*

Educational programs should include:

- *Trauma education integrated with the prehospital training program*
- *Continuing education tied to the quality improvement system*

Criteria evaluated by the agency should include:

- *Triage, patient delivery decisions, treatment, and transfer protocols integrated with the EMS and trauma system*
- *Ongoing quality improvement of triage/treatment/transfer criteria*
- *Policies, procedures, and/or regulations regarding on-line and off-line medical direction*

Certification to provide patient care by the agency should be based on standardized written and practical examinations given at regular intervals.

A system-wide quality improvement program should be established by the lead agency.

CURRENT STATUS

The Hawaii Department of Health EMSIPCS Branch is the lead agency for prehospital care throughout the state. The Branch contracts with organizations in each county to provide ALS transporting services. In addition, there are multiple agencies throughout the state that provide medical first response services.

The EMSIPCS Branch has historically been lead by the state EMS Director, supported by staff including the state EMS Medical Director and District (county) EMS Medical Directors. The state EMS Director and the state EMS Medical Director have both recently retired. The department is in the process of recruiting for the branch chief position, which, as a result of restructuring, will combine the positions of the state EMS Director and the state EMS Medical Director. This branch will assume lead agency responsibilities for trauma system development as that process evolves.

The EMS Branch contains sections responsible for: billing and collection (the Department of Health does all billing for EMS services provided in the state); standards development and review (transportation [vehicle, services, personnel and equipment], medical record keeping, evaluation and data analysis, facilities categorization, critical care units, and communications); systems management (manpower, training, public safety agencies, consumer participation, public information and education, accessibility to care, evaluation); emergency health mobilization (disaster response); and injury prevention and control. Branch staff includes program specialists, statistician, epidemiologist, and public health educator and support staff.

Hawaii EMS statute provides for the establishment of the EMS Advisory Committee (EMSAC) with representation from consumers and EMS system participants. The committee meets on a quarterly basis and serves in an advisory capacity to the Department on all matters relating to the state system. The state previously established a Trauma Systems Stakeholders Group which met several times in 2003 but has not met since.

Patient care protocols for EMS providers are uniform statewide. They are promulgated and reviewed bi-annually with input from constituents throughout the state. Those protocols address, in a general manner, the care of the trauma patient. Guidelines have been established, where appropriate, that suggest transportation destinations for selected patient populations, including trauma, based on a hospital facilities resource survey conducted in the mid 1990's. The island of Oahu has promulgated General Transportation Operational Standing Orders that identify a Prehospital Triage Guidelines Decision Scheme incorporating anatomic, physiologic and mechanism of injury components. That scheme identifies those patients who are to be transported by EMS personnel to the Queen's Medical Center. It appears that EMS personnel on the island of Oahu are frequently rerouted from their initial destination hospital, frequently to the Queen's Medical Center, based on on-line medical consultation at the time of transport. There do

not appear to be consistent guidelines for those rerouting decisions. Based on available destination resources located on neighboring islands, currently it is felt that there is no need for a destination triage decision scheme for those islands. A web-based resource tool will soon be implemented statewide that allows for real-time access to current hospital resource capabilities.

Trauma related education for EMS personnel is included in initial EMS provider education which requires completion of Prehospital Trauma Life Support (PHTLS). Recurrent completion of PHTLS is also required. In addition, there are trauma related continuing education programs for trauma care providers. Issues identified in the quality improvement program are used to define topics for subsequent education programs. Hawaii is a National Registry state.

Each EMS transporting agency is responsible for quality improvement activities for its organization. For some agencies, this includes case review and base station meetings with EMS personnel. Quality-of-care issues identified by the agency are communicated to the county EMS morbidity and mortality committee for further review. Information is also communicated to the state, although generally in a more informal manner. Prehospital quality of care issues identified at a receiving facility are communicated with the involved prehospital agency and reviewed by the county EMS M&M committee. The county M&M committees lack authority or capacity to effect change or improvement within the system. A statewide Air Medical Quality Improvement Committee is also in place to address issues related to air medical transport, but that committee also lacks capacity to effect change. There is no state peer review protection from discovery for prehospital quality improvement activities.

RECOMMENDATIONS

- **Recruit and employ the new state EMS Director as soon as possible. Charge that person to aggressively pursue trauma system development goals.**

- **Constitute a State Trauma Advisory Committee (STAC), with representation from all interested and affected disciplines, organizations and individuals.**
    - Establish County Trauma Audit Committees (CTAC) to address the local trauma systems issues and interface with the STAC.

- **Provide for prehospital peer review protection from discovery for quality improvement activities through appropriate mechanisms within the state (e.g. legislation or rules/regulations).**

- Conduct another facilities survey in the state, as part of state trauma needs assessment and gap analysis to identify resources available in hospitals to help define EMS personnel destination determinations for various patient groups.

- Establish a structured, active trauma prehospital peer review process encompassing ground and air transport components. Empower the Department of Health, through the STAC / CTAC, with the resources and authority to address issues identified by the QI process.

Ambulance and Non-Transporting Medical Unit Guidelines

Purpose

Each system should establish guidelines for non-transporting medical units (for example, quick response units) and for ground and air transportation that consider regulations, medical control, geographic boundaries, and topography.

- *Personnel should, at a minimum, be trained and certified/licensed at the EMT-basic level and should have off-line medical direction. On-line medical direction should be available.*

- *Safe, reliable ambulance transportation, whether by ground, air, or water, is a critical component of an effective system. The type of transport should be matched to the system's topography and demography. Distribution of ambulances should facilitate appropriate and timely emergency response for the trauma patient.*

- *Standards, policies, or procedures governing hospital destination must be in place.*

- *Protocols concerning the mode of transport of the trauma patient (air or ground) should exist. The method of coordination between air and ground and procedures for rendezvous should be specified by protocol. These protocols should be carefully coordinated between the emergency medical services system and the trauma system.*

- *Protocols should exist concerning the interface between transporting and non-transporting units.*

- *A process for ambulance certification/licensing and decertification must be in place to ensure that vehicles and services meet minimum standards, including the minimum equipment recommended by the American College of Surgeons and/or state lead agencies.*

- *Mutual aid agreements must be in place among emergency medical services providers to provide adequate ambulance coverage when resources within a system have been exhausted.*

- *There must be interagency agreements with public safety agencies (for example, police and fire) that security and safety of the injury scene.*

Medical Non-Transporting Unit Guidelines

- A process for medical non-transporting unit (for example, quick response units, rescue units providing a medical response without transport, and so on) certification/licensing and decertification must be in place to ensure that vehicles and services meet minimum standards.

- Personnel should, as a minimum, be trained and certified/licensed at the first-responder level and should have off-line medical direction.

- Protocols should exist concerning the interface between transporting and non-transporting units.

- There should be a placement strategy for non-transporting medical units to ensure they are located in areas where ambulance response may be delayed.

- There should be written agreements between non-transporting and transporting units clarifying, among other things, when non-transporting unit personnel ride with transporting units.

CURRENT STATUS

The Department of Health is responsible for ensuring the quality of services provided by prehospital agencies. The state inspects vehicles and licenses personnel. As noted below, several of the prehospital transport agencies have successfully undergone formal external review and accreditation. Indirect medical oversight for the EMS system occurs at several levels: the State EMS Medical Director, District (county) EMS Medical Directors, and agency EMS medical directors. Transporting agency personnel have on-line medical oversight via radio and/or telephone to emergency physicians in base hospitals. First response agencies are not required to have on-line or off-line medical oversight.

Ground prehospital ALS transport services in the State of Hawaii are provided by several organizations contracted by the Department of Health: City and County of Honolulu; Hawaii County Fire Department; and American Medical Response. Transporting units are minimally staffed with an MICT and an EMT, with MICT or EMT personnel staffing first response vehicles, either from police or fire service first response vehicles or ALS “fly car” first response vehicles. Transporting ambulances are strategically placed geographically around the islands of the state. Population and geography still make some areas of the state isolated, creating prolonged response and transport times.

Air medical services are provided by several organizations: Hawaii Air Ambulance (fixed wing / statewide); Air Med One (Rotary wing / 9-1-1 response capability for Maui County with limited inter-island transfer capabilities); Hawaii County Fire Department (rotary wing / 9-1-1 and interfacility response capability for Hawaii County); MAST (rotary wing / Oahu). There are

Army National Guard and US Coast Guard fixed wing and rotary wing aircraft resources in the state that have been used in certain specific situations in the past; they are not a part of routine resources available for patient transport. It is expected that the MAST program resources will be deactivated in 2006. Operational guidelines outline considerations for activation request for air medical services. American Medical Response is accredited by the Commission for the Accreditation of Ambulances Services (CAAS). Hawaii Air Ambulance is accredited by the Commission for the Accreditation of Medical Transport Services (CAMTS).

Most inter-island transfer of patients occurs via fixed wing aircraft. There are frequently prolonged time delays of transfer of patients secondary to limited fixed wing resource availability. Requests for fixed wing transport are frequently referred to a Hawaii Air Ambulance Medical Director for discussion and triage for prioritization into the transport cue.

The status of air medical programs in the state was reviewed in 1998 pursuant to a requirement established by the Legislature. This resulted in a report to the Legislature in 1999, outlining the Department of Health's strategic plan and progress report on the development of a statewide emergency aeromedical system. It appears that there has been little follow-up on the recommendations of that report.

RECOMMENDATIONS

- **Strengthen the air medical transport resources throughout the state.**
    - The geography of the state mandates that air medical transport capabilities for both primary field response and interfacility (intra-island and inter-island) transfers are critical to ensure appropriate access of care for all citizens and visitors of the state. This is especially so when faced with the anticipated loss of the MAST program in 2006.
    - Contract with the Commission for the Accreditation of Air Medical Services for an air medical services systems consultation. This consultation, in conjunction with the 1999 report to the Legislature regarding air medical services, should serve as the basis for future air medical services system planning.
    - The enhancement of air medical transport resources could include:
        - Augmentation of current resources available through Hawaii Air Ambulance
        - Utilization of Hawaii Army National Guard rotary wing aircraft/crews
        - Establishing a not-for-profit consortium or corporation for air medical services
        - Utilization of businesses providing tourist related helicopter services

- Regardless of the ultimate configuration, the air medical process should be overseen by an air medical oversight committee with the authority to effect appropriate performance improvement.

Communications System

Purpose

Each system should develop a prehospital communications system that is fully integrated with the remainder of the EMS and emergency/disaster preparedness systems. Beginning with the universal systems access number, the communications network should provide for prioritized dispatch, post dispatch instructions, dispatch-to-ambulance communication, ambulance-to-ambulance communication, ambulance-to-hospital communication, and hospital-to-hospital communication to ensure adequate EMS system response and coordination.

- *Medical direction and dispatch should be coordinated.*
- *An EMS dispatch protocol should be utilized.*
- *A 911 or enhanced 911 systems should be in place and should receive all public calls that request EMS response to trauma patients.*
- *All dispatch centers, vehicles, aircraft, and base stations should be equipped with adequate communications systems. Equipment must ensure that there are minimal geographic areas where communications cannot be established and that at least 95% of communications attempts are successful.*
- *Priority dispatch and post-dispatch instruction protocols should be in place.*
- *A quality improvement program should be in place.*

CURRENT STATUS

The statewide EMS communication system (hospital and prehospital) depends on outdated technology that is not fully functioning "leaving a cavernous gap in radio coverage." This situation is further hampered by extensive areas where communication by radio and cell phone is hampered by geography. There is a current plan to replace the existing system with newer technology through use of identified federal funds, but this is scheduled to occur over a three to four year period.

While there are 911 services available across the state, there is no centralized dispatch or uniformity of pre-arrival instructions. The OEMS does not license certified emergency medical dispatchers. There is no OEMS quality improvement plan that evaluates dispatch activities. All dispatch protocols are determined by local policies and procedures, consistent with the tradition

of operation through local oversight. It is unknown how many services have performance review of dispatch activities in place.

RECOMMENDATIONS

- Continue the critical activity of replacing the outdated statewide communication system, coordinated with other public safety agencies including the Office of Homeland Security.

- Develop a formal statewide communications quality improvement plan that integrates medical oversight and dispatch protocols.

- Review new communication technology options available for EMS/Public Safety agencies in the aftermath of 9-11 with an eye toward purchasing (implementing) a more comprehensive communication systems that incorporates EMS providers, law enforcement, hospitals, clinics and other critical infrastructure needed to handle day to day operations as well as mass casualty or other catastrophic events.

- Broaden the scope of communication needs to focus on the entire system so that the emergency medical response, and acute care facilities treating potential victims, are not left behind.

Emergency/Disaster Preparedness Plan

Purpose

Each system should develop a prehospital emergency/disaster preparedness plan that is fully integrated with the remainder of the EMS system, local government, private sector, and acute care facilities.

- *The system should have periodic educational exercises with post exercise review.*

CURRENT STATUS

The state of Hawaii has a very strong emergency management / civil defense program throughout the state. The Department of Health is in the process of revising its disaster plan based on all-hazards approach to natural and man-made incidents. It is also actively involved in the health-care related domestic preparedness activities. The Department is directly responsible for administering the CDC grant funds, through its Bioterrorism Preparedness & Response Branch. It contracts with the Hospital Association of Hawaii for the HRSA grant funds for EMS and hospital activities. There is very close interaction among the civil defense program, CDC grant initiative and HRSA grant initiative to ensure effective operational planning.

Honolulu has an active Metropolitan Medical Response System program coordinated through the City and County of Honolulu's Emergency Services Division. In addition, trauma surge capacity issues have been directly addressed in recent federal grant periods. Specifically, the state has developed 20 bed Acute Care Modules (ACM) to provide surge patient care resources – the first module (configured in a trailer for portability) was successfully drilled in August 2005 and is operational. Similar trailers will be provided to each county to support its surge care needs for equipment and supplies.

Surge needs regarding personnel resources are being addressed by several components. The Hawaii Disaster Medical Assistance Team (DMAT) has been reactivated and is operational and includes Medical Response Strike Teams (MRST). In addition to serving as a federal asset, the DMAT will serve as a ready available state resource. Hawaii is also implementing use of the federal Emergency System for Advance Registration of Volunteer Health Care Personnel (ESAR-VHP) for identification, cataloging and facilitating credentialing of health care personnel for personnel surge needs.

- **Continue the strong interface and cooperative interaction with Civil Defense / Emergency Management utilizing an all hazards approach for addressing the public health and health care needs for response to man-made and natural disasters.**

- **Continue planning activities with CDC and HRSA Domestic preparedness programs.**

    - The trauma system model is a good infrastructure model for such planning. This model allows for support of resources needed for daily and well as disaster / surge events.
    - HRSA planning critical benchmarks address and facilitate issues related to trauma and burn care and surge planning activities.

- Implement the ESAR-VHP program for inventorying, cataloging and credentialing health care personnel

- Investigate other potential surge capacity resources for care and transportation of trauma patients. Options include: tourist helicopters, tour buses, cruise ships.

Definitive Care Facilities

Purpose

Trauma Care Facilities

Injured patients should be delivered in a timely manner to the nearest appropriate facility. Regionalization of trauma care involves participation of hospitals that have the resources necessary to provide care for injured patients. A needs assessment study will provide an inventory of available resources, both human and physical, in the area to be regionalized. Trauma systems should be "inclusive" in nature, which means that the trauma care system will:

- *the needs of all injured patients requiring hospitalization for injury*
- *Utilize all qualified medical resources*

The trauma system plan should integrate all facilities into an inclusive system or network of definitive care facilities to provide a spectrum of care for all injured patients.

Trauma Centers

- *The trauma system lead agency should provide uniform standards for trauma centers (The criteria established by the American College of Surgeons Committee on Trauma and the Resources document are examples.)*
- *The trauma system lead agency should determine the optimal level and number of trauma centers, based on anticipated volume, available resources, and geography. This determination should be based on the needs assessment study. Reevaluation should be based on the quality management process plus volume and need.*

Other Trauma Care Facilities

- *The role and responsibility of other acute care facilities within the system should be defined and integrated in the evaluation process.*
- *The role and responsibility of specialty centers (pediatric, burn, spinal cord injury) should be defined and integrated in the evaluation process.*

Designation Process

- *Describe the process for selecting and designating trauma centers.*
- *Describe the process for monitoring all treatment.*
- *Describe process for re-designation and de-designation.*
- *Describe the process for adding other centers or deleting existing centers.*

CURRENT STATUS

Queen's Medical Center (QMC) has long been recognized as a statewide destination hospital for critically ill or injured patients. Over the past twenty years, QMC has worked to become a verified American College of Surgeons (ACS) Level II trauma center. This ACS verified trauma center is the only recognized trauma center in the state today. As such, QMC serves the citizens of Hawaii as the single definitive trauma care medical center. Other acute care facilities on Oahu appear to sporadically take care of injured patients, but none has a formal role in the trauma care system.

Currently, 1500 trauma patients annually receive their care at Queen's Medical Center. Transfers to QMC routinely occur from Oahu and other islands. The trauma patient volume continues to grow at QMC with the growth of the population, despite the fact that statewide growth is primarily in the neighbor islands.

Triage within the City and County of Honolulu appears to consist of all injured patients being transported to QMC, many inappropriately. This results in some system over triage to the hospital resource (QMC) that should primarily serve only those injured patients with severe or complex injuries. This over triage of less severely injured patients may overload the hospital physical plant and the care providers with patients that could be cared for at many other hospitals on Oahu. These other acute care facilities should be able to reliably care for patients with isolated fractures, closed head injuries without intracranial pathology on CT scanning, and simple soft tissue injuries.

Sole dependence on QMC creates a high level of vulnerability in the event of QMC physical plant failure or overload from natural or manmade causes. Pediatric trauma patient care in Hawaii does not make best use of available resources. Doctors at both QMC and Kapiolani Children's Hospital recognize pediatric trauma care as a system problem. All injured children are transported to QMC where care is provided by trauma surgeons without pediatric specialty training. Those children that require intensive care are monitored in an adult ICU without the benefit of pediatric intensivist consultation or pediatric surgeon care. Occasionally, a child who has been physiologically stabilized can be transferred to Kapiolani. Additionally, the pediatric

intensivists at Kapiolani, are willing to provide advice by telephone, but do not round on these children at QMC. The current arrangement does not meet the standard of care for the United States. Several solutions are possible; one should be selected and implemented.

On call pay has become an issue for the hospital and for specialists providing care for trauma patients at QMC and MMMC. This is a problem being faced by physicians and hospitals around the U.S. and has no simple solution. The relative shortage of specialists combined with the increasing recognition of the importance of lifestyle by physicians has created a dilemma: should hospitals have to pay physicians to be on call, how much, and which physicians? The Hawaii legislature recently decided not to become involved in this dilemma. However, it is clear that to develop a statewide trauma system, the State must make a financial commitment.

On occasion, QMC refuses trauma patient transfer from other hospitals because of inadequate orthopedic coverage. Currently, two committed orthopedic surgeons provide all the orthopedic trauma patient care at QMC. As trauma patient volume continues to increase, this model will not be sustainable. Even at the current trauma patient volume, these surgeons are unable to keep up. Additional orthopedic surgeon trauma call coverage at QMC is required immediately. Orthopedic surgery coverage is also a current problem for MMMC. During the months of September and October 2005, there were 4 to 10 days each month uncovered by the orthopedic surgeons because of call pay issues.

Tripler Army Medical Center (TAMC) is a military tertiary care hospital serving the entire Pacific basin for active duty military, their dependents, and military retirees. TAMC provides all routine medical and surgical services except for major burn care and transplant surgery. TAMC does not currently serve a defined role in the Hawaii trauma care system despite the fact that these military personnel constitute 10% of the population of the state.

Tripler Army Medical Center has a blood bank that is fully certified to do all testing in-house. The Blood Bank of Hawaii is an independent commercial entity that serves as the regional blood bank for all the islands, but must send some blood to Seattle for testing.

Straub Clinic & Hospital (SCH) serves Hawaii as the State burn center with 2 dedicated intensive care beds for burn victims. It was reported to the site visit team that, on occasion, SCH refuses burn patient transfer when their two beds are full. A backup plan does not appear to exist. Children with major burns are frequently transferred to the mainland, which is appropriate care.

Maui

Maui Memorial Medical Hospital (MMMC), a 231-bed facility, is an unrecognized state treasure. This facility is the only acute care hospital in Maui County; as such it serves as the primary medical care center for the islands of Maui, Lanai, and Molokai. MMMC also serves the citizens of the big island on an intermittent basis for complex patients, such as trauma patients. The only neurosurgeon in the eastern half of the state of Hawaii is Dr. D. Thomas Rogers, who has worked at MMMC for the past seven years (and takes neurosurgery call 24/7).

The team visited MMMC at the conclusion of the group discussion. It appears that the growing physical plant could function as a Level II trauma center. The medical staff commitment is obvious. As this facility continues to grow and plays an increasingly important role in trauma care for the eastern half of the state, its other specialty areas will also mature. If the 200 chest pain patients that are currently transferred from MMMC to Oahu could stay at MMMC, this would serve to decompress the air medical transport system resulting in more timely transfer of patients that can only be cared for on Oahu.

Hawaii

Care for the injured patients on the Big Island of Hawaii is provided by three main hospitals: Kona Community Hospital, Hilo Medical Center, and North Hawaii Community Hospital. Each hospital has General Surgeons on staff and Anesthesiology immediately available by call. Orthopedic Surgery is available on island, but seems to be variable as to capacity to care for the severely injured patient 24/7. All of these hospitals have the capability to handle urgent surgical trauma. There is no trauma registry being used on the island, and none of the hospitals are evaluating or trending their trauma care data. There are no formal triage or destination protocols for trauma patients; however, there appears to be a general understanding between the prehospital providers and hospitals. There are no interfacility transfer agreements.

North Hawaii Community Hospital is one hour by ground from Hilo Medical Center or Kona Community Hospital. Hilo Medical Center and Kona Community Hospital are about two hours apart. According to ambulance destination data provided by the EMS Branch, Hilo Medical Center receives 54% of the trauma patients on the island. Kona Community Hospital receives 29%, and North Hawaii Community Hospital receives 17%. All of the Big Island hospitals have in-house CT and MRI. They also have 24/7 in-house Emergency Medicine. Vascular surgery, cardiology, and dialysis are provided only at North Hawaii Community Hospital.

Management of head-injured patients on Hawaii is an issue. All of the hospitals on the Big Island expressed continued concern about their ability to get severely head-injured patients to definitive care in a timely manner. This was verbalized as the care providers' number one concern on Hawaii.

Kauai has two hospitals, one on either end of the island. Kauai Veterans Memorial Hospital (KVMH) is a Critical Access Hospital that is state funded. Trauma patients brought to KVMH are resuscitated and sent to Wilcox Memorial Hospital or to Oahu. Wilcox Memorial Hospital has orthopaedic surgeons, neurologists, three general surgeons, and other primary care physicians. There is interest among the surgeons to provide quality trauma care locally to the patients, commensurate with local resources. Patients with operative head injuries are transferred to Oahu, some to Straub Clinic and some to Queen's Medical Center. This is not appropriate because in an inclusive trauma system, all critical trauma transfers are transferred to designated trauma centers (e.g. QMC), not an affiliated hospital (e.g. Straub).

- **Queen's Medical Center should become a Level I Trauma Center.**
    - Queen's Medical Center (QMC) should remain the heart of the Hawaii trauma care system. QMC leadership should strive to meet the standards of and seek verification by the American College of Surgeons as a Level I trauma center. A Level I trauma center in Hawaii would serve as the appropriate benchmark against which all other trauma care facilities in the state can be measured.

- **Organize the trauma resources in the State into an Inclusive Trauma Care System.**
    - All acute care hospitals within the state should be organized into, and participate in, an inclusive trauma care system at a designation level commensurate with the resources of each and the needs of the local community. Development of such an inclusive system would be expected to result in fewer minimally injured patients being transported to QMC which, in turn, will reduce the current burden of overtriage on QMC.

        - By creating a trauma system with Level III and II trauma centers in the neighbor islands, a significant amount of the ISS <15 trauma can be managed at the local level. This would alleviate some of the strain on QMC by reducing the amount of lower severity trauma transfers, and conserve resources needed to manage the more severe trauma patients at QMC.

- **Develop a backup capacity plan for Oahu.**
    - A minimum of at least one more trauma center with Level II or III capability should be designated on the island of Oahu as the Hawaiian Islands are in such a remote and isolated geographic location. One option would be for Kaiser to serve as a Level III trauma center. Other options include having Tripler to serve as a disaster backup to QMC or having Tripler serve as the day-to-day Level II or III trauma center for all active duty military, military retirees, and military dependents in the state.

- **Resolve deficiencies in pediatric trauma care.**
    - Develop protocol-driven pediatric trauma care: This should include formalized collaboration that includes (at a minimum) Queen's Medical Center, Kapiolani Medical Center for Women and Children (KMC), QMC trauma surgeons, KMC pediatric surgeons, and KMC pediatric intensivists. This protocol should include written transfer agreements and documented early involvement in care of the pediatric trauma patient by pediatric specialists.
    - Consideration should be given to other alternatives for care of the injured child, for instance, children younger than eight admitted to an intensive care unit should have early bedside consultation by a pediatric intensivist (whether this occurs at a QMC ICU or after early transfer to Kapiolani Children's pediatric surgery

service). Children admitted with lower acuity injuries should routinely receive pediatric or pediatric surgery consultation after hospital admission.
    - Develop an integrated pediatric QI program: The QI umbrella for injured children in the state needs to include: prehospital care, transport care and timing, QMC care, trauma surgeon involvement, pediatric specialist involvement (pediatrician, pediatric intensivist, pediatric surgeon), and outcome data. With these care providers joining in a single joint pediatric QI process, the ideal solution for provision of optimal care for injured children in Hawaii will become clear.

- **Maui Memorial Medical Center should be a designated trauma center.**
    - MMMC should seek state designation and American College of Surgeons verification as a Level III trauma center and eventually develop into a Level II. Resolution of orthopedic surgeon call coverage is mandatory. Recruitment of an additional neurosurgeon will become ever more important as patient volume and acuity increases. Consistent vascular surgical coverage is desirable.
    - As a designated member of a statewide inclusive trauma care system (particularly as a Level II trauma center), MMMC should become the receiving facility for both Maui County and the Big Island. This will result in more timely care for injured patients in these counties.
    - A general surgeon trauma director should be appointed.

- **Resolve the lack of neurosurgery coverage across the islands.**
    - The issue regarding optimal treatment of the brain-injured patient on Hawaii will require thoughtful collaboration. This process needs to be evidence-driven from data obtained from the hospitals and medical transport systems. Decisions regarding the recruitment and optimal location of neurosurgical specialists and development of a functional triage and transfer system will require not only ongoing data collection, but a continued performance improvement process. Treatment of traumatic brain injury (TBI) patients on the neighbor islands should be addressed as follows:

        - Develop a mandatory data collection tool for TBI patients statewide.
        - Develop a statewide transfer protocol that includes prioritization of the TBI patient in the transport queue.
        - Incorporate the published evidence-based guidelines for management of TBI patients into clinical protocols that can be used to treat the patient awaiting transport.
        - Employ a performance improvement process based upon the data collection tool and the input of the neurosurgeons.
        - Consider incorporation of telemedicine into treatment protocols.
        - Consider provision of training in emergency craniotomy and neurotrauma care to the neighboring islands. This education will be lifesaving when patient transfer is impossible secondary to weather or disaster.

- **Designate trauma center(s) on the Big Island.**
    - The three major hospitals on the Big Island should collaborate to collect data and study trauma care on the island. Using the information gained, the acute care hospitals should be organized as part of the statewide inclusive trauma care system.
    - There should be at least one Level III trauma center on the Big Island, and after studying the weather patterns and ability to transfer patients, the system may need to include a Level III trauma center on each side of the island.

- **Designate a trauma center on Kauai.**
    - The hospitals on Kauai should collaborate to collect trauma patient data and study trauma care on the island. Using the information gained the acute care hospitals should be organized as part of the statewide inclusive trauma care system.
    - There should be at least one trauma center on Kauai, likely a Level III. Issues regarding consultation and sharing of radiology images need to be resolved to insure that trauma patients are transferred to a higher-level trauma center (Level II or Level I) rather than to a larger hospital that is not a trauma center.

- Develop an MOU between the State and Queen's Medical Center.
    - An MOU should be created that specifically designates QMC as a trauma center. In turn, the State, by contract, should expect to receive data on at least an annual basis from the hospital trauma registry. The finances of caring for the uninsured trauma patient may also be included in the MOU. As additional trauma centers are designated by the State, similar MOU's should be created.

- Develop a formal role for Queens trauma medical director in State Trauma System Leadership:
    - The lead trauma medical director may serve in an official or ex officio status within the Department of Health. The opportunity for this individual to have a profound positive impact on system development must not be overlooked.

- Recruit orthopedic surgeons and other specialists required.
    - QMC needs to have more than two orthopedic surgeons on call for the current trauma patient volume. There may need to be financial incentives to encourage additional orthopedists to take call at QMC. As the patient volume increases the current model is clearly not sustainable.
    - QMC should consider instituting destination fees for trauma system patients to offset the cost of specialist call pay and in-house operating room, radiology, and other staffing for trauma patient care

- Develop backup burn patient capacity

- A written statewide plan should be developed to provide alternate care sites or additional dedicated beds for major burn patients when Straub Clinic & Hospital is unable to provide care with its current two bed commitment. As Hawaii does not have a large number of burn patients, a centralized site (as now exists) for the care of these patients results in maximum experience for the involved care providers, with the potential for optimal outcomes. Thus, additional bed capacity for burn patients at Straub Clinic & Hospital is the ideal solution, unless QMC decides to take on this responsibility.

- Enhance the capability of the Blood Bank of Hawaii.

    - As Tripler has the only stand-alone blood bank in the state, the State should encourage or mandate that the Blood Bank of Hawaii take steps to achieve the maximum certification available (so as not to depend on being able to ship blood to Seattle for testing).

Inter-facility Transfer

Purpose

Central to the concept of an inclusive trauma system is the provision for appropriate and expeditious transfer, when necessary, of injured patients between acute care facilities. The decision to transfer a trauma patient should be based on objectively agreed upon criteria that pertain to transfers to both higher and, where appropriate, lower levels of care. Established transfer criteria will minimize discussions about individual patient transfers and ensure optimal patient care. It is essential that the transfer agreements include provisions required under the Consolidated Omnibus Reconciliation Act (COBRA) and subsequent revisions of the Act.

Inter-facility transfer is particularly important in the following situations:

- *Linkage between the urban and rural components of a trauma system*
- *patients requiring specialty facilities, such as pediatrics, burns, and spinal cord injury, or the need for further rehabilitation*
- *Movement of patients between acute care facilities and trauma centers*
- *Appropriate transfer of patients between trauma facilities*
- *Movement of patients from trauma facilities back to local communities when appropriate*

The process of transferring injured patients from acute to rehabilitation care facilities will be facilitated by establishing written transfer agreements between acute and rehabilitation care facilities in the system. The decision to transfer spinal cord injury (SCI) and traumatic brain injury (TBI) (severe/ moderate TBI) patients to rehabilitation facilities that provide specialized programs in SCI and TBI should be based on objectively agreed upon criteria.

Inherent in the transfer of any trauma patient is feedback from the receiving to the transferring facility.

- *The trauma system should ensure that inter-facility transfers occur in a timely fashion commensurate with patient's clinical needs*

- *The trauma system should establish standards for the mode of transportation and qualifications of transport personnel*

- *The trauma system should have a model transfer agreement*

- *The trauma system should ensure that all inter-facility transfers are based on patient needs and are in the best interest of the patient*

- *Trauma centers should have transfer agreements with rehabilitation centers that provide specialized programs in SCI and TBI*

- *Trauma centers should have transfer agreements with rehabilitation centers that provide inpatient and intensive outpatient rehabilitation for patients with diagnoses other than SCI or severe/moderate TBI, such as mild TBI, amputations, burns, or other major injuries deemed appropriate for rehabilitation*

- *The trauma system should be cognizant of the cost issues and ensure the most cost-effective strategies that are consistent with optimal care*

- *A process (CQI) to measure patient outcome as it relates to transfer should be in place.*

CURRENT STATUS

Given the geographic isolation of much of the population of Hawaii, the necessity for air transportation, and the completely exclusive nature of the existing trauma system, a seamless process of the inter-facility of severely injured patient is essential. Currently, established transfer criteria and written transfer agreements do not exist for trauma patient transfer within the state of Hawaii except for a single interfacility transfer agreement between QMC and Straub Clinic. Transfer agreements serve both to define the appropriate patient population for transfer as well as to facilitate transfers through preplanning. See **Purpose** above.

Ground transport between facilities on each island appears adequate based on information provided to the site review team. However, inter-island air transport is problematic due to a gap between supply and demand. The lack of air transport resources sufficient to serve the needs of the growing populations on the neighbor islands is among the greatest threats to the lives and limbs of injured Hawaiians.

Hawaiian Air Ambulance (HAA), in operation since 1978, logs more than 2000 medical flights annually using fixed wing aircraft and covers all major islands. Many individuals interviewed by the site review team were concerned about the long delays in trauma patient transport related to inadequacies in the current fixed-wing transport system. System delays appear to be related to

several factors. These include: variable patient volume, lack of adequate numbers of aircraft and/or air crews, and competition between transferring hospitals and doctors to have their patients transported in a timely manner for time-sensitive injuries or illnesses.

Lack of timely access to definitive care, currently available only on Oahu, may adversely affect survival from injuries on the neighbor islands. This may be especially true on Kauai as it is the only major island without its own island-based air medical transport system. Several individuals reported to the site review team that twelve-hour delays have occurred in inter-island transfer of patients, including trauma patients.

Maui Air Ambulance covers Maui County (Maui, Molokai, Lanai) for trauma and other medical evacuation needs using rotorcraft. These helicopters are primarily used to transport patients from the scene to Maui Memorial Medical Center (MMMC) or from other acute care facilities to MMMC. On occasion, they are also used to transport patients from MMMC to Queen's Medical Center (QMC).

QMC currently receives approximately 180 trauma patients annually from the neighbor islands. In 1994, 122 of the 182 trauma patient transfers to QMC were from the Big Island, 25 from Kauai, 22 from Maui, 10 from Molokai, and 3 from Lanai. Fifty-nine of these patients overall had an Injury Severity Score of nine or less, indicating that they likely could have been cared for at a Level III trauma center were one available in the respective counties. An inclusive trauma care system statewide would minimize the necessity to transfer some of these less severely injured patients to Oahu, thus decreasing the load on the air transport system.

The MAST (Military Assistance to Safety and Traffic) program currently provides all air medical transport on Oahu. On occasion, MAST will provide service to other islands on a case-by-case basis. It is recognized that the Oahu MAST unit may be lost if the 25th Infantry Division moves to another state at some time during the next 12 months as is currently projected.

Hawaii Army National Guard's (HIARNG) helicopters stationed on the islands of Oahu and Hawaii are not currently available for trauma care evacuation. Some other states (e.g. Oregon) make National Guard helicopters available for civilian interfacility transport on a case-by-case basis. The Coast Guard does provide C130 transport planes for medical air evacuation from the neighbor islands when patient weight exceeds the airframe limitations of the other air transport services.

RECOMMENDATIONS

- **Develop Transfer Agreements between acute care facilities**
  - Establish transfer criteria and interhospital transfer agreements that cover all types of patients and all acute care facilities within the state. The most important of these are the transfer agreements between acute care facilities and trauma centers for the transfer of the severely injured patient to a higher level of care.
  - The transfer agreements should ideally include:

- Criteria and process for transfer
- Process ensuring rapid transfer & acceptance for the more severely injured patients
- Mechanism for ensuring pre-transfer specialty consultation as needed
- Mechanisms ensuring continuity of care
- Repatriation provisions
- Provisions ensuring the sharing of PI and outcome data

- **Develop plans for MAST loss now**
  - Alternate plans need to be made now for the potential loss of the Oahu MAST program. This may provide an opportunity to study an idealized complete reorganization of medical air evacuation with the state, including state sponsorship (as exists in Maryland).

- **Analyze current air evacuation system**
  - Interfacility transfer limitations in the Hawaii trauma care system are almost exclusively those relating to transport by air. A systematic analysis of the current system should be performed to include: numbers of transports (from which site/hospital to which hospital), time from first call to time of aircraft arrival, patient outcome, and morbidities/mortalities or potential morbidities/mortalities associated with delays in transport. External resources such as those available through a variety of national air medical groups my prove useful in this endeavor and lend an unbiased perspective to the existing challenges.

- Involve Army National Guard in trauma system development.
  - Efforts to explore integration of Army National Guard helicopters into the state trauma care system should be made. These large helicopters could be used to take a critical care transport team from Queen's Medical Center to a neighbor island for evacuation of patients with critical medical or surgical illnesses (as occurs in Oregon).

Medical Rehabilitation

Purpose

As an integral component of the trauma system, rehabilitation centers provide coordinated post-acute care for trauma patients who have sustained catastrophic injuries, resulting in permanent or long-standing impairments.

The trauma system should demonstrate strong linkages and transfer agreements between designated trauma centers and rehabilitation centers located in its geographic region (in or out of state).

- *The trauma system should convene a joint liaison committee to be comprised of appropriate health professionals from designated trauma centers and rehabilitation centers (for example, trauma surgeon, physician with expertise in rehabilitation, physical therapist, occupational therapist, nurse case manager, hospital administrator, and so on).*

- *Input from payors should be sought.*

- *The trauma system should ensure that the rehabilitation process begins in the acute care facility as soon as possible.*

- *To maintain clinical expertise and skills, each rehabilitation center that provides specialized programs in SCI and TBI should have a critical mass of patient volume in SCI and TBI.*

- *Each rehabilitation center that provides a specialized program in TBI should have an appropriately qualified Medical Director for TBI. It is recommended that the Medical Director of the TBI Program meet all of the following requirements: (a) have two years of experience in brain injury rehabilitation and/or completed a fellowship in brain injury, and (b) have board certification in a specialty field of medicine.*

- *Each rehabilitation center that provides inpatient and intensive outpatient rehabilitation for trauma patients should have an appropriately qualified Medical Director for Rehabilitation. It is recommended that the Medical Director of Rehabilitation meet the following requirements: (a) have two years of experience in rehabilitation and/or completed a fellowship in a rehabilitation specialty, and (b) have board certification in a specialty field of medicine.*

- *The trauma system should encourage clinical pathways for the major traumatic diagnoses that affect patients' rehabilitation outcomes.*

- *The trauma system should identify and collect, at appropriate times, the necessary data elements for analyzing patient outcomes and evaluating the effectiveness of the trauma system. Data to be collected may include:*
    - *new injury admissions per year of SCI, TBI, and dual-diagnosis patients to each rehabilitation center*
    - *indicators of patient severity, including complications (for example, ASIA classification system for SCI, Glasgow coma scale for TBI)*
    - *time between acute care and initiation of rehabilitation*
    - *acute care length of stay*
    - *length of stay at rehabilitation center*
    - *functional independence measure (FIM) score*
    - *facility or location to which patient was discharged*
    - *type of outpatient rehabilitation care received (for example, hospital-based, home, nursing home).*

- *The trauma system should have data exchange procedures that will provide feedback (for example, patient outcomes, effectiveness of delivery system, and so on) to the trauma, acute care, and rehabilitation care providers.*

- The trauma system should conduct long-term outcome research in rehabilitation of trauma patients and provide for appropriate dissemination of research results.

CURRENT STATUS

Medical rehabilitation in Hawaii consists largely of a single rehabilitation facility, Rehabilitation Hospital of the Pacific, on the island of Oahu. Additional clinics are present on Maui and on the Big Island, but these are not of the type that is necessary for inpatient rehabilitation of patients with brain and spinal cord injury. Occasionally, rehabilitation patients are transferred to mainland hospitals, especially those with high spinal cord injuries.

There were no physiatrists or specific representation for the Rehabilitation Hospital of the Pacific at any of the site visits made by the review team; therefore, the following recommendations are made based on the limited information made available to the review team. Based on the information provided to the SVT, it does not appear that rehabilitation protocols exist system-wide or that there is rehabilitation data collection and/or exchange.

- Develop inpatient rehabilitation capacity within each county, as possible
    - As head injured or spinal cord injured patients frequently have long term rehabilitation treatment plans, it would be ideal for every major island to have its own rehabilitation center (so that families can remain involved in the care of their loved ones on a daily basis).
    - On islands where the number of patients requiring rehabilitation is too small to warrant an independent rehabilitation facility, transfer to Oahu (as occurs now) is acceptable, given that there exist adequate rehabilitation beds within the state to meet the need. Skilled nursing facility beds cannot substitute for rehabilitation beds.

Information Systems

Purpose

The ideal trauma care system has an information system which provides for the timely collection of data from all providers in the form of consistent data sets with minimum standards. The information system should be designed to provide system-wide data that allow and facilitate evaluation of the structure, process, and outcomes of the entire system, all phases of care, and their interactions. An important use of this information is to develop, implement, and influence public policy. Policies and procedures to facilitate and encourage injury surveillance and trauma care research should be developed, including:

- *System-wide plan for collection and collation of trauma care data and cost data should be encouraged*
- *Definition of minimum data sets*
- *Well-defined roles and responsibilities for agencies and institutions regarding data collection*
- *Process to evaluate the quality, timeliness, and completeness of data*
- *Process to ensure appropriate patient and provider confidentiality*
- *Data acquisition from all the appropriate sources. These can include:*

    1. *Law enforcement, crash, and incident reports*
    2. *Prehospital care reports \ run sheets*
    3. *Emergency department data*
    4. *Trauma registry*
    5. *Hospital discharge data, including rehabilitation and specialty care facility*
    6. *Medical examiner/coroner records*
    7. *Death certificates*
    8. Payor records

CURRENT STATUS

There are multiple information sources and databases available in the state, in various stages of sophistication. Many of these computerized databases are available to the Department of Health for system review and analysis. The Injury Prevention and Control Section currently has access to 9 of the 11 Core Data Sets:

- Vital Records
- Behavioral Risk Factor Surveillance Survey (BRFSS)
- Youth Rick Behavior Surveillance Survey (YRBS)
- Hospital Discharge Data (HDD)
- Medical Examiner Data (Honolulu)
- Occupant restraint use observational data
- Fatal Accident Reporting System (FARS)
- Uniform Crime Report (UCR)
- Emergency Medical Service Run Report (EMS)

In addition, emergency department discharge information, including E-codes, is collected. Essential data that is currently not available for analysis include law enforcement crash reports and payer records related to trauma patient care. Formal trauma registry data is only collected at Queen's Medical Center, using the Collector Registry. The Department of Health has addressed issues of confidentiality and HIPAA compliance for data collected. There currently are no systematic linkages of these databases, making organized information sharing and analysis very cumbersome and difficult.

The state is in the process of a staged implementation of a web-based electronic patient care record for EMS over the next year. It is anticipated that initial implementation will begin in early 2006. Once operational, this system will allow for near real-time collection and review of information. In addition to facilitating EMS data collection, analysis and performance improvement, it will also facilitate needed surveillance for domestic preparedness activities.

RECOMMENDATIONS

- **Establish a formal statewide trauma registry incorporating all hospitals in the state.**
  - Incumbent on developing this process is the need for funding support to all hospitals in the state for trauma registry development and maintenance. This must include a web-based or other alternative data entry mechanism to facilitate data entry from the most remote facilities.

- **Ensure timely implementation of EMS electronic data collection throughout the state.**
  - Establish early implementation of data analysis obtained from electronic system.

- Establish formal linkages among the available databases noted above. Electronic linkages will allow for rapid, consistent system review and assessment.

- Establish a mechanism with the health care payer community to get information on costs associated with all components of trauma care.

- Obtain access to crash records from the Department of Transportation

- Establish a goal of and project timeline for obtaining state crash data and apply for participation in the NHTSA Crash Outcome Data Evaluation Systems (CODES) project.

Evaluation

Purpose

The trauma care system should monitor its own performance and the performance of its components. This evaluation should include continual reassessment of system operations and goals as they relate to patient needs, availability of appropriate resources, and costs. It is essential to measure compliance to standards, document system effectiveness, and identify quality improvement opportunities. System evaluation should include:

- *System-wide quality management plan*
- *Lead agency responsible for system quality management plan*
- *Monitoring of system performance and performance of individual components*
- *A periodic review and update of system standards as they relate to patient needs, system resources, and costs*
- *Periodic review and update of trauma facility standards*
- *A quality improvement process that assesses the effectiveness of the trauma system*
- *A quality improvement process that measures the compliance to standards by each agency and institution*
- *A process to ensure patient and provider confidentiality*
- *A process to require and ensure appropriate facility quality management programs and appropriate interaction between facility quality management programs*
- *A process to determine the changes and incentives (risks and benefits) in caring for trauma patients*

CURRENT STATUS

Based on the discussion at the plenary sessions on Oahu, Maui, and Hawaii, there appears to be considerable interest in evaluating and improving the overall function of the existing trauma system, from prehospital providers, physicians, and hospital representatives. There also appears to be a certain amount of frustration, on the part of individual providers, at the perceived inability to affect change in the current system of trauma care, and the current lack of comprehensive, system-wide performance improvement.

Trauma performance evaluation, monitoring, and improvement currently occurs in a variety of settings:

- Queen's Medical Center has a functioning performance improvement program as an essential component of a verified Level II trauma center. There exists an informal process of providing feedback, typically by telephone, to referring hospital providers in cases of questionable or inadequate care.
- The Hawaii EMSIPSC Branch conducts quality management through a well-described process. Issues identified by providers or patients are subjected to a review process and referred, as needed to the EMS M&M committee for review & action. The prehospital database will soon be converted to an electronic format, which should allow for indicator-based EMS quality management, monitoring of guideline/policy compliance, and linkage to other databases (e.g. state trauma registry as it becomes available).
- Child Death Review system, implemented in 1997, reviews all deaths of persons under 18 years of age. While not specific to trauma, this system provides multidisciplinary review for the purpose of formulating policies and strategies for treatment and prevention.
- The statewide air medical transport committee considers issues related mostly to inter-island air transport problems, and transport availability.
- Community hospital performance improvement committees, required by JCAHO, conduct case-specific reviews of care.

Although PI does occur among the various system components (prehospital, acute care, etc.), meeting minutes are sparse due to concerns regarding medico-legal 'discoverability'. There is no systematic reporting of PI proceedings to state or municipal agencies, and the capacity to track & monitor action plan effectiveness and "loop closure", among most existing PI committees appears to be limited. As yet, there is no established system-wide plan or mechanism for the conduct of more comprehensive trauma system performance improvement. The underpinnings of such a process such as a statewide trauma registry and a committee responsible for system-wide PI has yet to be developed. As a result, indicators reflective of day-to-day system function, such as over- and under-triage are not captured or monitored.

- **Appoint & convene a State Trauma Advisory Committee (STAC), under the aegis of the EMS & Injury Prevention System Branch, whose charge includes the development a comprehensive, system-wide trauma performance improvement (PI) plan.**
    - Develop County Trauma Audit Committees (CTAC) for the counties of Honolulu, Maui, Hawai'i, and Kaua'i, that are charged with the responsibility of conducting local trauma PI. These county committees would report up to the STAC for system-wide issues.
    - As additional acute care facilities are designated & verified as trauma centers (Level II – IV), develop a system-wide process that includes case-based, multi-institutional, multidisciplinary peer review.

- **Develop a system-wide plan for trauma performance improvement (PI) plan, including indicators relevant to the specific problems faced by the state of Hawaii (e.g. time-to-definitive care), and a process whereby ongoing trauma PI system monitoring can occur. This plan should include:**

    - A detailed process for both case-based (sentinel) reviews, indicator-based analysis, and physician peer review.
    - A set of system-based quality indicators, including over- and under- triage rates, time-to-definitive-care, etc.
    - A role of County Trauma Audit Committees (CTACs) as well as existing committees such as EMS morbidity & mortality committee and the Child Death Review System.
    - A mechanism to allow recording & tracking of PI meeting minutes without exposure to medico-legal 'discoverability'.
    - A mechanism for developing practice management guidelines for early trauma management that can be 'operationalized' at all levels of the trauma system. These guidelines would compliment and enhance existing EMS management policies and protocols.
    - A process for reviewing trauma-related PI processes at participating trauma receiving hospitals.

- Develop and utilize a statewide trauma registry to identify PI problems within the state, to target potential solutions, and provide "loop closure" for specific system-wide PI interventions.
    - Develop the capacity to link this database to other databases (EMS, trauma center) to further enable indicator-based PI monitoring.

- Develop a process for the conduct of more comprehensive outreach based on specific clinical issues identified by the trauma system PI process, for neighbor island and Oahu trauma receiving hospitals.

- This outreach might include, clinical and organization education, assistance with the implementation of practice management guidelines (PMG), and external peer review.

- Incorporate existing medical expertise at the lead trauma center (QMC's) to provide medical leadership for trauma system PI.
  - In most cases, the Trauma Medical Director at the system's lead trauma center plays an integral role in developing and conducting system performance improvement. A specific role in trauma system's PI and development for the Queen's Medical Center TMD (or other uniquely qualified trauma physician) should be considered, including specific system-based responsibilities and commensurate salary support.

Research

Purpose

The system should facilitate and encourage trauma-related research. The system should facilitate epidemiological research in prehospital care, acute care, rehabilitation, and prevention.

- *There should be a process to facilitate access to data for trauma-related research, including, but not limited to:*

    a. *Cost-effective research*
    b. *Outcomes research*
    c. *Epidemiology*
    d. *Injury control research*
    e. *Quality-of-life research*

- *There should be a process to acquire funding for research.*

- *There should be a definition of the research requirements from each system component and for each type of facility.*

CURRENT STATUS

Research within the trauma system in Hawaii is conducted as a function of its individual components. There is peer-reviewed research published from providers at Queen's Medical Center who have faculty appointments at the University of Hawaii. Additionally, there has been publicized trauma related research by physicians at Tripler Army Medical Center (TAMC). Topics of this peer reviewed trauma-related research have included studies of the impact of methamphetamine use on a trauma system; critical care metabolic studies, and investigation involving traumatic brain injury. There is considerable body of reports, many of excellent quality, produced by the Injury Prevention program, but few of these are published in peer-review journals. There is currently no statewide system trauma registry to aid with the conduct of system-wide research.

There was previously a separate School of Public Health at the University of Hawaii, Manoa, but this was absorbed, as the result of funding issues, into the School of Medicine. The Department of Public Health Sciences & Epidemiology was established in 2000. Part of its mission is: "to conduct research relevant to state, national and international health needs; to engage in research activities with agencies dedicated to promoting health and preventing disease, disability and

premature mortality…" This mission would appear to be consistent with addressing the major health need of improving injury prevention and care within the state, and working collaboratively with the DOH-OEMSIPB in improving the trauma system of care through targeted research.

RECOMMENDATIONS

- **Develop a working relationship between trauma clinicians, the State Injury Prevention & Control Section, and the University of Hawaii to enhance trauma system research efforts.**

- Establish and utilize a statewide trauma registry and prehospital data system to support trauma system's research.

- Based on opportunities identified by state registry analysis and the Injury Prevention & Control Section, develop a system-wide research agenda.

Focused Questions

Question Posed

1. **What are the essential elements and critical 'next steps' to allow sustained development of the trauma system in the state of Hawaii?**

Surveyor Response:

Despite its importance as a preventable cause of morbidity and mortality, trauma often is given a lower priority in the context of public health. This occurs for several reasons: the lack of public and legislative awareness of both the prevalence and potential preventability of trauma-related death and disability, limited private advocacy groups (e.g. breast cancer survivors), misassumptions about the capabilities of existing hospitals and systems, and other more visible health care priorities (e.g. cancer, heart disease, pediatrics). Public (and legislative) education is essential in increasing this awareness and correcting these misassumptions and forms the basis for legislative and financial support for trauma systems.

A recent Harris Poll (Harris Interactive, 2005) revealed that 90% of Americans felt that it was "extremely important" or "very important" to have a trauma system in place in their state, 62% would be "extremely concerned" or "very concerned" to find that they lived out of easy reach of a trauma center, 78% would be willing to pay for trauma centers and a trauma system in their state.

A somewhat unique impediment to trauma system development for the state of Hawaii is related, in part, to its own success: the highly functional nature of the central, existing Level II trauma center, and the sometimes implicit assumption that this center is the trauma system. The state of Hawaii has the opportunity to make major advances in the development of a functional, inclusive trauma system and to take advantage of the lessons learned by other states with more developed systems. Much of the groundwork for the Hawaii system has been completed and a number of critical components (well organized state EMS system, injury prevention, committed high volume Level II trauma center) are already in place.

The most critical elements pertain to the identification or recruitment of good trauma system leadership, including a dedicated role for state trauma program management, the establishment of an authorized structure for directing the development of the trauma system and overseeing its operations, and the creation of a comprehensive trauma plan. These elements are not necessarily high cost items, and their implementation should not be limited to small incremental steps.

- **Recruit essential leadership:**
  - Develop a position or assign specific job responsibilities to existing staff for ongoing state trauma system development.
    - Utilizing BT or HRSA Trauma/EMS funds to support this position, (no application for the HRSA Trauma/EMS funds has been submitted for the past 2 years), if no other sources are available.
    - Utilize state trauma program manager job descriptions from other states (e.g. Wyoming, North Carolina) as a template for this position
  - Ensure that the trauma medical leadership at Queen's Medical center(e.g. the TMD) has a codified role in the development and operation of a state trauma system.
    - In some states/regions, a specific set of responsibilities for a state trauma medical director (reporting to the state EMS medical director), has been developed. Funding for this part-time position should be developed as necessary.

- **Establish a formal structure with the authority to help implement trauma system assessment, development, and evaluation**
  - Appoint a State Trauma Advisory Committee (STAC). Integrate this into existing state Department of Health committee structures.
  - Ensure proper administrative staff to support the activities of the STAC (e.g. state trauma program manager)
  - Appoint regional / county Audit Committees (CTAC) to conduct trauma evaluation/PI at the local level with the involvement of county agencies, EMS, and providers.

- **Formulate a comprehensive trauma plan**
  - This must include system-wide quality management and performance improvement
  - Utilize existing state trauma plans contact of the Federal Trauma and EMS TA Center for examples

- **Engage system stakeholders in the development and operation of the trauma system.**
  - Providers. The incentives should be professionalism, the availability of system-wide outreach & education, and proper financial incentives to support clinical involvement
  - Institutions. The incentives should include transfer & operating agreements.
  - Organizations and coalitions for trauma-related activities
  - Agencies: municipal, prevention, other
  - Contractors, businesses
  - Public service / citizens groups

- **Promote public & legislative support for the trauma center and trauma system**
  - Develop a plan for ongoing public education
  - Develop a strategy for legislative education
  - Enlist community and advocacy group support

- **Develop financial model for ongoing support of the trauma system**
  - Set priorities:
    - Administrative support
    - Professional and institutional incentives
    - Under- and un-funded patient care
  - Evaluate revenue sources and the applicability of existing models for system funding (see Appendix C)
  - Explore the role and capability of municipal agencies to assume leadership and some degree of financial responsibility for county-specific trauma systems.

Question Posed

2. **How can access to neurosurgical care for traumatic brain injury patients, particularly those on neighbor islands, be improved?**

Surveyor Response:

The lack of neurosurgeons on several of the neighbor islands, particularly more populous islands, such as Hawaii and Kauai, has posed a problem for definitive care of neurotrauma patients, particularly those with traumatic brain injuries (TBI) in whom time to neurosurgical care directly affects outcome. Since TBI is the most common cause of morbidity and mortality post trauma, this is a critical issue. Ground transport times to the local hospitals can be as long as two hours with additional time being required for transport off-island to the neurosurgeons on Oahu. Currently, patients are not transferred from other islands to Maui. Long waits for transportation are common due to the organization of the air medical transport system.

To address this issue, data regarding TBI patients need to be continuously collected from all of the hospitals, with a minimum data set including: time and mechanism of injury; admission Glasgow Coma Score; radiographic diagnoses, especially regarding extraaxial hematomas; time from injury to disposition decision, arrival at neurosurgical hospital, and to definitive care (i.e., surgical decompression of extraaxial hematomas); and outcome (at least mortality and Glasgow Outcome Score performed at discharge and six-month post-injury). These data may then be used to assess what the neurosurgical workforce needs are, to improve design of the transportation system, to educate providers appropriately for the types of injuries seen, and to guide the performance improvement process.

Protocols for prioritization of brain-injured patients within the queue for medical transport need to be put into place. This amounts to implementing a more sophisticated triage system with immediate transport of critical neurotrauma patients. The current air ambulance system indicated that such procedures are followed, yet anecdotal reports of very lengthy waits for critical patients were given by providers, suggesting a possible insufficiency in the availability of aircraft and/or crews. No data specific to this issue (TBI patient transfers) were provided, so a complete assessment could not be performed at this time, but this is a critical issue that needs to be addressed by the trauma system. See also the section on Inter-island Transfer.

Existing, published evidence-based guidelines should be incorporated into the development of clinical protocols to treat neurotrauma patients before, during, and after transport to the trauma center.. Available guidelines include those regarding prehospital management of TBI, management and prognosis of severe traumatic brain injury (adult and pediatric), penetrating brain injury, surgical management (publication pending), spinal cord injury, and others. Since the QMC has ACS trauma center verification, there should be a lead neurosurgeon identified who can participate in the processes of outreach, education, and performance improvement, and who could provide medical leadership for this process.

Consideration should be given to incorporating telemedicine (e.g., review of images with neurosurgeons on Maui or Oahu for those patients on islands without neurosurgeons). Confidentiality issues should not be an obstacle, since the neurosurgeon would in effect be acting as a consultant. There are ongoing efforts underway to address the medicolegal implications of telemedicine, and follow-through until a well-defined process for telemedicine consultations is in place is encouraged.

While recruitment of a neurosurgeon to the Big Island may be considered ideal,, the likelihood of success, due to the population base and practice issues (e.g., requirement for continuous call) makes this unlikely for the time being. The addition of a second neurosurgeon to Maui with a protocol in place to transfer patients from Hawaii to Maui could be considered as a somewhat more viable alternative. This would reduce the time from injury to neurosurgical care. Additionally, since there is already one neuruosurgeon practicing on Maui, addition of a second neurosurgeon there would add long-term viability to that program by reducing the single physician's call burden and ensuring a neurosurgical presence after his retirement. Adequate support services exist there, including a committed hospital, ICU, and an interventional neuroradiologist, which would make this a more attractive option for an incoming neurosurgeon. Cost of living and reimbursement issues would need to be assessed.

A less desirable but potential alternative would incorporate a training program for non-neurosurgical physicians or physician extenders who have been well trained by neurosurgeons in the placement of intracranial pressure monitors or emergency burr holes for damage control. This would require working in conjunction with a neurosurgeon via remote communication if necessary and could not occur outside a rigorous QM process. This should not be done in the absence of a process to improve transfer times and time from injury to definitive therapy provision by a neurosurgeon for appropriate patients. Furthermore, such procedures should not interfere with or delay transfer, because there is evidence that outcomes are improved when the time to reach neurosurgical care is reduced. This option may be viable for situations in which weather precludes transport, but the number of incidents that occur may be so rare as to limit provider competence. If so, educational programs where neighbor island providers regularly work at the trauma center may need to be employed. Local liability issues may preclude this from occurring altogether.

Recommendations

Treatment of traumatic brain injury (TBI) patients on the neighbor islands should be addressed as follows:

- Develop a statewide mandatory data collection tool for TBI patients. Data collection should include but not be limited to the following:
    - All ED admissions with TBI
    - GCS scores
    - Radiographic diagnoses (with special attention to extraaxial hematomas, i.e., subdural hematomas and epidural hematomas, as these are typical surgical emergencies)
    - Time from injury to decision to transfer, arrival at receiving hospital, and time to definitive care by neurosurgeon, e.g., surgical decompression
    - Outcomes data such as mortality, Glasgow Outcome Score at discharge and six months

- Develop a statewide transfer protocol that includes prioritization of the TBI patient in the transport queue.
- Incorporate the published evidence-based guidelines (available online) for management of TBI patients into clinical protocols that can be used to treat the patient awaiting transport, such as
    - Management and Prognosis of Severe Traumatic Brain Injury
    - Guidelines to the Prehospital Management of Severe Traumatic Brain Injury
    - Guidelines for the Acute Medical Management of Severe Traumatic Brain Injury in Infantc, Children, and Adolescents
    - Guidelines to the Management of Penetrating Traumatic Brain Injury
    - Implement mechanism for tracking and monitoring of compliance with a system-wide PI process.
- Implement educational programs regarding these clinical protocols to include first-responders, family physicians and emergency physicians who may be the receiving and stabilizing physicians prior to transport, and trauma surgeons
    - Consider training neighbor island physicians (probably trauma surgeons) on basic neurotrauma procedures, e.g., placement of intracranial pressure monitors to guide treatment, burr hole drainage of acute hematomas, under the guidance of a neurosurgeon who will be providing definitive care.
- Consider incorporation of telemedicine into treatment protocols.
- Employ a performance improvement process based upon the data collection tools, clinical protocols, and the input of the neurosurgeons.

Question Posed

3. **What is the rate of over triage at Queen's Medical Center?**

Surveyor Response:

There is concern from the physicians and administration at QMC that there are multiple transfers from other medical centers with minimal injury. This is felt to cause bottlenecks and delays of the system at QMC. Additionally, it places an undue burden on call schedules.

QMC provided trauma registry data on the numbers of admissions and the breakdown into ISS categories. This was compared to the National Trauma Data Base. (Figure 1). There does not appear to be an inordinate number of the lower ISS patients admitted to QMC.

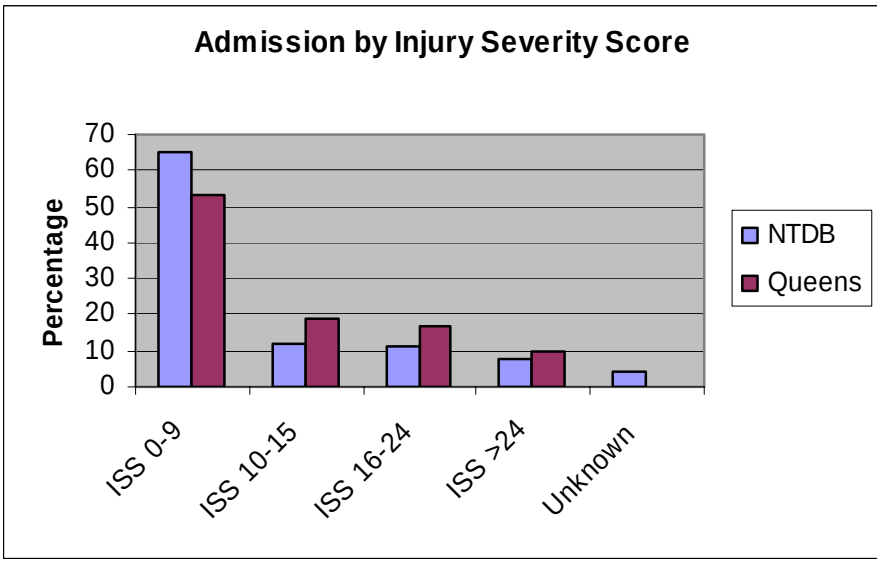


Figure 1: Comparison of Queens ISS distribution to NTDB aggregate data. The lower ISS group, ISS 0-9, is one indicator of the patients that might be treated at lower level trauma centers or acute care facilities.

Data on the numbers of transfers from neighbor islands with ISS categories, and the numbers of those that were subsequently discharged in less than three days was evaluated. Of all the transfers from neighbor islands, those with an ISS > 16 were 39%. This would suggest that an appropriate ratio of the transfers into QMC from the outer islands are indeed severely injured. The island with the most transfers was the Big Island of Hawaii. They also had the largest percentage of patients that were discharged within 72 hours, but the average for all the islands was only 13% of the off-island transfers.

The overall numbers of minimally injured patients transferred to QMC by acute care hospitals on Oahu are not consistent with excessive over-triage, although these data do not include patients transferred but dischared from the ED. However, over triage may be occurring intermittently when it is not convenient for subspecialists to provide coverage. Off hours transfer of patients to QMC of patients with injuries that are normally treated at the transferring hospital during the day

is not a transfer to higher care. This is a concern that the transferring hospital will have to address with their subspecialists.

Inappropriate medical control redirection of patients who do not meet field triage criteria to the trauma center may be occurring. Redirection is not currently documented on the EMS run sheets, and is not being tracked. The City and County of Honolulu must track these data to allow for effective analysis of the issue.

These concerns need to be addressed at the County Trauma Audit Committee (CTAC), with representation by physician leaders of all acute care hospitals. This underscores the importance of developing the CTAC and empowering it to function. Individual hospitals working to enforce subspecialist issues will not be as fruitful as a legislatively authorized committee with representation from all of the hospitals working on common issues and problems.

Further resolutions for the perceived over-triage would exist in the development of the trauma system. Establishing an inclusive trauma care system with verified trauma centers on the neighbor islands should decrease transfer of patients with lesser injuries. The trauma director from QMC should play a lead roll in assisting the potential directors in the development of trauma centers on the neighbor islands.

This collaboration will establish a group of trauma directors from all the islands that can serve as a core for a Medical Audit Committee for the islands. Any of these committees must report to a legislatively empowered performance improvement committee such as the State Trauma Advisory Committee (STAC).

RECOMMENDATIONS

- Develop, through the STAC, a consensus-based definition of trauma over and under-triage.
- Periodically review the under- and over- triage rates for the Hawaii system
    - Utilize the QMC database to calculate Level 1 over triage
    - Utilize hospital discharge data (UB-92) and the ICD/AIS map to determine ISS and estimate under-triage at non-trauma center facilities.
- Use over- and under- triage data to guide subsequent policy development for appropriate inter-facility transfer of trauma patients.

Question Posed

4. **How can Hawaii increase the efficiency and effectiveness of existing and/or future air medical resources?**

Surveyor Response:

Hawaii is unique in that injured persons from outlying rural and frontier areas can not be transported to the highest levels of trauma care by ground. Whereas in many rural and frontier areas of the U.S. air medical transport is a "luxury" that can be called into play when it is available, on Hawaii is a "necessity" that plays a critical role in the very survival of many trauma patients. In addition, delays in the transfer of what may start as manageable neurotrauma lesions can result in costly long-term care as they become inoperable due to delays to definitive care. The savings from the elimination of unnecessary long-term costs could offset costs associated with a more effective transport system.

The Hawaii Trauma System can never be stronger than its weakest link and, at this point in time, inconsistencies in timely transport is one of the weaker links in the current system. The data available suggests that more than 150 patients deemed serious enough for transfer to Queen's Trauma Center from neighboring islands had transport times of 6 to 12 or more hours (Queens' Medical CenterTrauma Registry, 2005). While associated outcome data is not available, this degree of delay, by most standards, would be considered excessive. Delays in transport within the existing system were attributed, in discussions with stakeholdes, to a number of factors that fell into three general categories.

1. Delays in receiving confirmation of referral acceptance from the tertiary hospitals which is a pre-requisite for being placed in the queue for air medical transport.

2. Fluidity within the scheduling queue caused by changing priorities based on "criticality" of patients awaiting transport.

3. Perceptions that aircraft and crews are not stationed or dispatched in the most efficient configurations.

While Hawaii Air Ambulance is to be commended for its long-standing dedication and service to the citizens of Hawaii, the population growth on the neighbor islands and the associated increase in major injury may have outstripped the available resources. .

In addition to timely transfer, ongoing performance improvement is a key concept of an organized and inclusive trauma system. The existing air medical transport committee is an important element in reviewing problems associated with interfacility transport. The effectiveness of this committee to implement improvements to the transportation system might be enhanced if were to be incorporated into the overall quality management structure of the

trauma system. In spite of the private, entrepreneurial, nature of the primary air medical transport provider, the oversight committee must have the authority and mandate to cause system improvements to happen.

The Air Medical Transport Sub-Committee should, ideally, have the opportunity to conduct performance improvement activities on the rotor wing services provided by Maui and Hawaii counties. The trauma patients of the state of Hawaii will be best served by the proper utilization of all available air medical transportation resources when they are brought to bear on the problem in a well-planned and integrated fashion. This may include expansion or re-definition of mission.

As the needs and expectations of the Hawaii Trauma System evolve, certificate of need processes may need to be modified or waived if the process impedes the deployment of essential air medical resources.

Recommendations

- The air medical transport committee should be re-constituted as a sub-committee of the Emergency Medical Services Advisory Committee and given the responsibility and authority needed to substantially improve the timeliness of transfer of critically injured trauma patients.
- Consider a formal, focused, external evaluation, through CAMTS or a similar agency, of the current air medical transports system for Hawaii.

Appendix A: Site Visit Team – Biographical Sketches

ROBERT C. MACKERSIE, M.D., F.A.C.S

Dr. Mackersie is the Director of Trauma Services at San Francisco General Hospital, a Professor of Surgery at the University of California, and the Chair of the Trauma Systems Planning and Evaluation Committee for the American College of Surgeons. He is an actively practicing trauma and general surgeon with an interest in surgical critical care and post-traumatic inflammatory lung injury.

Dr. Mackersie received his undergraduate degree in Mechanical Engineering from the University of California, Berkeley; his medical degree from Michigan State University, and completed his residency in General surgery at the University of California San Francisco, including a two year NIH sponsored lab fellowship. He is board certified in General Surgery and Surgical Critical Care.

He previously served on the faculty of the University of California, San Diego. Dr. Mackersie has lectured extensively in the United States as well as internationally in Canada, Australia, Brazil, and Argentina. He has had a long involvement in the educational aspects of trauma, and has supervised fellowship programs in trauma, critical care, and violence prevention. He serves as a trauma center surveyor for the ACS-COT Trauma Verification & Review Committee.

Dr. Mackersie has authored or co-authored over 100 publications, mostly on trauma-related topics. He has had a long involvement in academic and professional aspects of general and trauma surgery and surgical care. Some of his other activities have included:

1. Governor, American College of Surgeons
2. President, Northern California Chapter, American College of Surgeons
3. Chief of Staff, San Francisco General Hospital
4. Past Chairman, COT Committee on Education, American College of Surgeons
5. Chairman San Francisco Trauma Systems Audit Committee
6. Member, ACS Committee on Trauma Executive Committee
7. Author, “Resources for Optimal Care of the Injured Patient 2006” (Am. College of Surgeons)
8. Board of Managers, Western Trauma Association
9. Secretary/Treasurer, HC Naffziger Surgical Society - UCSF
10. Professional & Academic societies including: American Association for the Surgery of Trauma, Western Trauma Association, Society of Critical Care Medicine, Society of University Surgeons, Pacific Coast Surgical Association, Southwestern Surgical Association, and others.

CHRISTOPH R. KAUFMANN, MD, MPH, FACS

Dr. Kaufmann is Associate Medical Director, Trauma Services at Legacy Emanuel Hospital in Portland, Oregon. He attended medical school at the Uniformed Services University of the Health Sciences (USUHS) in Bethesda and completed his general surgery residency at Tripler Army Medical Center, Honolulu, Hawaii. He then completed the Trauma/Critical Care Fellowship at Harborview Medical Center in Seattle. He is board certified in general surgery and surgical critical care.

In 1990, while on the teaching faculty of Madigan Army Medical Center in Tacoma, Dr. Kaufmann was deployed with the 47th Combat Support Hospital to Saudi Arabia and Iraq. In 1993, Dr. Kaufmann was assigned to the USUHS Department of Surgery with responsibility as trauma consultant to the U.S. Public Health Service. He served as Director, Division of Trauma and Emergency Medical Systems, Health Resources and Services Administration (HRSA), where he administered the federal grant program to develop trauma care systems across the United States. He also participated as an author of the Model Trauma Care System Plan. In 1996, he returned to the Department of Surgery at USUHS as Principal Investigator of the Demonstration Project for Telepresence Surgery. He served as Chief, Division of Trauma and Combat Surgery, and Region Chief, American College of Surgeons Military Committee on Trauma. Dr. Kaufmann was the Surgical Director of the National Capital Area Medical Simulation Center and Professor of Surgery at USUHS at the time of his retirement from the U.S. Army in 2002. He is now Chair of the Advanced Trauma Life Support (ATLS) Subcommittee for the ACS Committee on Trauma.

Dr. Kaufmann is an author of the current revision of the HRSA Model Trauma Care System Plan. He has given over 100 presentations in 16 different countries. He has been a member of numerous local, state, national and international committees, both military and civilian, relating to trauma systems and trauma care, including:

Member, Trauma Systems Consultation Committee, ACS Committee on Trauma
Associate Examiner, American Board of Surgery
Executive Committee, American College of Surgeons Committee on Trauma
Site Surveyor, ACS Trauma Center Verification & Review Committee
Trauma Center Site Surveyor, Virginia, Pennsylvania, Illinois, and Washington
Member, Committee on a Vision for Space Medicine Beyond Earth Orbit, Institute of Medicine
Editorial Board, NATO Emergency War Surgery Handbook, 3rd U.S. Revision
President, Ambroise Pare Military Surgical Forum of ISS-SIC
Examiner, Society of Apothecaries of London, Diploma in the Medical Care of Catastrophes

JON R. KROHMER, MD, FACEP

Dr. Krohmer is the former Medical Director of Kent County EMS in Grand Rapids, MI. He is also an Associate Professor of Emergency Medicine at Michigan State University and Director of EMS of the Emergency Medicine Residency at Spectrum Health Downtown Campus in Grand Rapids. He is a past president of the Michigan College of Emergency Physicians and the National Association of EMS Physicians.

Dr. Krohmer has been involved in EMS activities for over 25 years. He is a graduate of the University of Michigan Medical School and completed an EM residency and an EMS/research fellowship at Wright State University in Dayton.

He has been very active with the American College of Emergency Physicians at the national and state levels and the National Association of EMS Physicians. He is past president of NAEMSP. He was a long member of the ACEP EMS and the Trauma Care and Injury Control Committees and is a past Chair of both committees. He is the 1998 recipient of the ACEP Outstanding Contribution to EMS Award and the 2003 recipient of the NAESMP Ronald Steward Award for contribution to national EMS activities. He is the ACEP and NAESMP liaison to the ACS COT and is a past president of the Michigan Trauma Coalition and has been very active in trauma systems development in Michigan. He is a consultant to the CDC Division of Injury Response regarding EMS and trauma issues.

MS. MARGARET TRIMBLE

Ms. Trimble has worked for over 35 years in emergency medical services and trauma systems. These years have encompassed training, clinical care and research in both civilian and military careers. She has presented at conferences nationally and internationally, is an author of EMS related articles and chapters and the recipient of many awards including the prestigious military proficiency designator in trauma nursing for significant achievement and contributions.

With a master's degree in health care administration and doctoral level studies in health policy, Ms. Trimble's career included twenty-five years of trauma and EMS work with the Maryland EMS System and in the University of Maryland Hospital's Trauma Center. She was part of the leadership team that developed that trauma center and the statewide EMS and trauma system and served for many years as the state Director for EMS Nursing and Specialty Care. The specialty care branch included system management for specialty populations such as the high-risk neonate and high-risk maternal patients, pediatric emergencies, burn and behavioral emergencies. Her clinical areas of practice included open-heart surgery, hyperbaric medicine, burn and trauma critical care. The span of system involvement ranged from injury prevention to rehabilitations.

As the Director of an Army Medical Training Center from 1991-1997, LTC Trimble, was responsible for training medical units in the most up-to-date doctrine and procedures, supporting application research support for new equipment and exercise testing of interoperability for joint service operations. This center pioneered distance learning medical training for the Army National Guard and developed special expertise in biological and chemical casualty medical care.

Ms. Trimble was the state EMS director for Pennsylvania (Director of the Emergency Medical Services Office, Pennsylvania Department of Health) from 1997 to 2004 managing one of the country's largest EMS systems. In this capacity, she directed statute and regulatory, both development and enforcement; trauma system support and integration; system budgetary, credentialing, licensing; emergency preparedness and response; education and training; and clinical protocols, quality review and medical command designation and credentialing. Research and progressive information system projects promoted database linkages for system improvement during this time.

Presently the Chief of Staff for a FEMA disaster assistance center in California, Ms. Trimble continues to work special projects such chairing the Department of Homeland Security's initiative for credentialing EMS personnel for disaster response roles and the resource typing of EMS assets for interstate mutual aid and she continues to consult with HRSA for the Trauma/EMS Model Trauma System Plan.

NELS D. SANDDAL, MS, REMT-B

Mr. Sanddal is currently the president of the Critical Illness and Trauma Foundation (CIT), in Bozeman, Montana. CIT is a non-profit organization dedicated to improving the outcomes of people who are injured in rural America through programs of prevention, training, and research. He also serves as the Director of the Rural EMS and Trauma Technical Assistance Center which is funded by the Department of Health and Human Services, Health Resources and Services Administration. He received his EMT training in Boulder, Montana, in 1973 and has been an active EMT with numerous volunteer ambulance services since that time. He currently responds with the Gallatin River Ranch Volunteer Fire Department where he serves as the Medical Officer and Assistant Chief. Mr. Sanddal worked as the training coordinator for the EMS and Injury Prevention Section of the Montana Department of Public Health and Human Services in the late 1970's. He has served as the Chairperson of the National Council of State EMS Training Coordinators and as the lead staff member for that organization, as well as the National Association of EMT.

Mr. Sanddal has been a co-investigator for six state or regional rural preventable trauma mortality studies and has conducted research in the area of training for prehospital and nursing personnel as well as in rural injury prevention and control. He is a core faculty member for the NHTSA Development of Trauma Systems course and has conducted several statewide EMS assessments for NHTSA. Mr. Sanddal currently serves on the IOM Committee on the Future of Emergency Care in the U.S.

He completed his undergraduate work at Carroll College, received his Master's degree in psychology from Montana State University and is currently completing his doctorate in Health and Human Behavior from Walden University.

REGINALD A. BURTON, MD, FACS-Observer

Dr. Burton started his career in Trauma in high school when he got his first EMT certification. He worked as an EMT throughout college and medical school to offset his tuition. He moved to Ohio after finishing his residency in Surgery in 1990.

Dr. Burton was very active in the establishment of the Trauma System in Ohio. He developed and was the Trauma Director of the first ACS verified level III trauma center in Ohio, while continuing to participate in trauma call at the Level I trauma center in Dayton. He gave numerous lectures throughout the state on trauma center development, trauma center Performance Improvement programs, and EMS/Hospital integration of trauma plans. He became the medical director for the Fire/EMS services in two surrounding cities and sat on the regional EMS Council. He was the Co-Chairman of the Southwest Ohio Regional Trauma System from 1997 until 2002. He was the Chairman of the Region 2 Physician Advisory Board to the Ohio State Trauma Board for 5 years until he moved to Nebraska. He sat on the Data Committee of the Ohio Trauma Board during the statewide trauma registry development, and helped work out many issues enabling it to start functioning 2000.

Dr. Burton is currently the Trauma Director, Chair of the Division of Trauma, and Surgical Critical Care Director for BryanLGH Medical Center in Lincoln, Nebraska. He is a Clinical Associate Professor in Surgery at the University of Nebraska. He is the Region 2 Trauma Director in the Nebraska Statewide Trauma System. He is the Chair of the Nebraska Statewide Trauma Performance Improvement Committee, and the author of the Nebraska Trauma Performance Improvement training workshop. His team developed a web-based trauma registry reporting system that has enabled small critical access hospitals in rural Nebraska to report their trauma data to the Nebraska Statewide Trauma Registry.

Dr. Burton has been a site visitor for the ACS Verification Committee since 2000. He became the Chairman of the Nebraska ACS Committee on Trauma in 2002. He was the ACSCOT representative to the National EMS Workforce Stakeholders Meeting and the HHS State Trauma Leadership meeting this year. Dr. Burton was also involved in the ACS Political Action Taskforce briefing on trauma issues to state senators and congressmen in Washington, D.C. in March, 2005. Dr Burton has always been an outspoken advocate for Trauma System Development.

SHELLY D. TIMMONS, MD, PhD, FACS- observer

Shelly D. Timmons, M.D., Ph.D., is a neurological surgeon with Semmes-Murphey Clinic in Memphis, Tennessee. She has been Assistant Professor of Neurosurgery and Chief of the Neurotrauma Division of the University of Tennessee Health Science Center Department of Neurosurgery and Chief of Neurosurgery at the Regional Medical Center at Memphis/Elvis Presley Memorial Trauma Center in Memphis since 1997. She is also Assistant Dean of Graduate Medical Education at UTHSC.

Dr. Timmons earned her medical degree at the University of Illinois College of Medicine at Peoria in 1991, completed her residency training in neurological surgery in 1997 and her Ph.D. in 2002, both at the University of Tennessee Health Science Center-Memphis. She has been active in clinical research in traumatic brain injury and traumatic vascular injury, undergraduate and graduate medical teaching, development of evidence-based guidelines, and in several professional organizational activities, including those of the Executive Committee of the Joint Section of Neurotrauma and Critical Care of the American Association of Neurological Surgeons and Congress of Neurological Surgeons.

Appendix B: List of Hawaii Participants

Name	Title/Affiliation
Larry Alfrey	PA/Queen's Medical Center
Address	Phone /E-Mail
1301 Punchbowl Street Honolulu, 96813	(808) 547-4048 lalfrey@queens.org

Name	Title/Affiliation
Andy Ancheta	OPS Manager/American Medical Response
Address	Phone/E-Mail
99-840 Iwaiwa St, Aiea 96701	(808) 487-4900 andy.ancheta@amr.net

Name	Title/Affiliation
Anela Angell	MICT/AMR – Maui EMS
Address	Phone
230 Hana Hwy Ste 12b, Kahului 96732	(808) 281-7713

Name	Title/Affiliation
Therese Argoud	Childhood Injury Prevention Coordinator/ State of Hawaii, Department of Health
Address	Phone/E-Mail
1250 Punchbowl Street, Room 214, Honolulu 96813	(808) 586-5940 therese.argoud@doh.hawaii.gov

Name	Title/Affiliation
Speedy Bailey	Director/American Medical Response
Address	Phone/E-Mail
99-840 Iwaiwa St, Aiea 96701	(808) 487-4900 speedy_bailey@amr-ems.com

Name	Title/Affiliation
Navy Capt. (Dr.) Kevin Berry	Deputy Commander for Clinical Services /Tripler Army Medical Center
Address	Phone/E-Mail
1 Jarrett White Road, Honolulu 96859	(808) 433-5781 Kevin.berry@hau.tamc.amedd.army.mil

Name	Title/Affiliation
Rod Bjordahl, D.O.	Chief Medical Officer/Maui Memorial Medical Center
Address	Phone
221 Mahalani Street, Wailuku, 96793	(808) 293-3085

Name	Title/Affiliation
Clay Chan	EMS Program Specialist/DOH-EMSS
Address	Phone/E-Mail
1250 Punchbowl Street, Honolulu 96813	(808) 733-8328 clayton.chan@doh.hawaii.gov

Name	Title/Affiliation
Cherylee Chang, MD	Medical Director/Queen's Medical Center's Neuroscience Institute/Stroke Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 537-7152 cchang@queens.org

Name	Title/Affiliation
Alyssa Chapital, MD, FACS	General Surgery, Surgical Critical Care/Queen’s Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street Honolulu, 96813	(808) 586-2920 chapital@hawaii.edu

Name	Title/Affiliation
Libby Char, MD	Director/City and County Emergency Services Department
Address	Phone/E-Mail
3375 Koapaka Street, Honolulu 96819	(808) 831-4351 lchar@honolulu.gov

Name	Title/Affiliation
Annie Ching, RN	ER, Straub Clinic & Hospital
Address	Phone/E-Mail
888 South King Street, Honolulu 96813	(808) 522-3781 Hawaiisiscokid@aol.com

Name	Title/Affiliation
Krista Hopkins Cole	Injury Prevention Coordinator /City and County Emergency Medical Services Division
Address	Phone/E-Mail
3375 Koapaka Street, Suite H-450, Honolulu 96819	(808) 831-4376 kcole1@honolulu.gov

Name	Title/Affiliation
Rebecca Donovan, RN	Director, Emergency Services/Kaiser Permanente Medical Group
Address	Phone/E-Mail
3288 Moanalua Rd, Honolulu 96819	(808) 432-7020 rebecca.Donovan@kp.org

Name	Title/Affiliation
Patty Dukes	Chief, City and County of Honolulu EMS
Address	E-Mail
3375 Koapaka Street, Suite H-450 Honolulu 96819	(808) 831-7103 pdukes@honolulu.gov

Name	Title/Affiliation
Chiyome Fukino, MD	Director, Hawaii State Department of Health
Address	Phone/E-Mail
1250 Punchbowl Street, Honolulu 96813	(808) 586-4410 chiyome.fukino@doh.hawaii.gov

Name	Title/Affiliation
Dan Galanis, PhD	Epidemiologist/Injury Prevention State of Hawaii-Department of Health
Address	Phone/E-Mail
3375 Koapaka Street, Suite H-450, Honolulu 96819	(808) 586-5943 djgalani@mail.health.state.hi.us

Name	Title/Affiliation
Sam Gingrich, MD	NHCH Emergency Department
Address	Phone/E-Mail
67-1125 Mamalahoa Highway, Kamuela, 96743	(808) 885-7545

Name	Affiliation
Hao Chih Ho, MD	Interim Assoc Medical Director, Trauma/Queen's Medical Center
Address	Phone/E-Mail
2228 Liliha St. Ste 402 Honolulu 96817	(808) 586-2924 haochihho@aol.com

Name	Title/Affiliation
Kara Hughes	Public Relations/Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 547-4975 khughes@queens.org

Name	Title/Affiliation
Dan Jessop	Chief Operating Officer/Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 547-4721 djessop@queens.org

Name	Title/Affiliation
Sally L. Jones, RN	Trauma Coordinator/ Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 578-8601 sjones@queens.org

Name	Title/Affiliation
Edward J. Kalinowski, M.Ed, DrPH	EMS Coordinator, Department of EMS Kapiolani Community College
Address	Phone/E-Mail
4303 Diamond Head Road, Honolulu 96816-4496	(808) 734-9330 kalinows@hawaii.edu

Name	Title/Affiliation
Pat Kalua	Vice President/St. Francis Medical Center
Address	Phone/E-Mail
2226 Liliha St., Honolulu 96817	(808) 547-6425 patk@sfhs-hi.org

Name	Title/Affiliation
Calvin Kam, MD	Neurosurgeon/Queen's Medical Center
Address	E-Mail
2228 Liliha St. Ste 402 Honolulu 96817	(808) 536-3579 calvinkam@lova.net

Name	Title/Affiliation
Terry Kelbaugh	Owner/Dolphin Pearl Aviation
Address	Phone/E-Mail
PO Box 1060, Kamuela, 96743-1060	(808) 345-4271 tkelbaugh@hawaii.rr.com

Name	Title/Affiliation
James Kimmel	MICT/AMR – Maui EMS
Address	Phone
230 Hana Hwy Ste 12b, Kahului 96732	(808)898-3035

Name	Title/Affiliation
Wega Koss, MD	General Surgeon/ Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 585-5494 wkoss@queens.org

Name	Title/Affiliation
José B Lee	EMS Program Specialist/DOH-EMSS
Address	E-Mail
1250 Punchbowl Street, Honolulu 96813	jblee@aloha.com

Name	Title/Affiliation
Shon Magslon, RN	Critical Care Supervisor, Hilo Medical Center
Address	Phone/E-Mail
1190 Waianuenue Avenue, Hilo 96720	(808) 974-6941 smagrath@hhsc.org

Name	Title/Affiliation
Wendy Miyamoto, RN	Trauma Clinical Database Coordinator/ Queen's Medical Center
Address	Phone/E-Mail

2228 Liliha St. Ste 402 Honolulu 96817	(808) 537-7031 Wmiganoto@queens.org
Name	Title/Affiliation
Curt Morimoto	OPS Manager/AMR – Maui EMS
Address	Phone
230 Hana Hwy Ste 12b, Kahului 96732	(808) 871-2153
Name	Title/Affiliation
Dave Nelson, MD	ER Maui Memeorial/ Medical Director Maui AMR
Address	Phone/E-Mail
230 Hana Hwy Ste 12b, Kahului 96732	(808) 572-5734 dhelson@hawaii.rr.com
Name	Title/Affiliation
Steven Nishida, MD	Trauma Surgeon/ Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 524-0066 stevend@aloha.net
Name	Title/Affiliation
Lisa Nishikawa, RN	Trauma Clinical Database Coordinator/Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 547-4247 lnishikawa@queens.org
Name	Title/Affiliation
Zach Octavio	OPS Manager/ AMR-Kauiai EMS
Address	Phone/E-Mail
99-840 Iwaiwa St, Aiea 96701	(808)245-4675 zachary_Octavio@amr-ems.com
Name	Title/Affiliation
Susan Orr, RN, MS	Senior Clinical Consultant/Healthcare Association of Hawaii
Address	Phone/E-Mail
932 Ward Avenue, Suite 430, Honolulu 96814	(808)864-0173 sorr@hah-emergency.net

Name	Title/Affiliation
Chris Paik, RN	Chief Flight Nurse/Hawaii Air Ambulance
Address	Phone/E-Mail
PO Box 30242, Honolulu 96820	(808) 722-5259 cpaik96734@aol.com

Name	Title/Affiliation
Lawrence Peebles, MD, FACS	Chief of Surgery/Kona Community Hospital
Address	Phone/E-Mail
79-1019 Haukapila St, Kealakekua 96750	(808)896-2363 larry@lapeebles.com

Name	Title/Affiliation
Larry Prosser	Pacific Helicopters
Address	Phone
Kahalui Airport Hangar, #109, Kahalui, 96732	(808) 281-9278 thepross@hawaii.rr.com

Name	Title/Affiliation
Ginny Pressler, MD	Senior V.P./Hawaii Pacific Health
Address	Phone/E-Mail
55 Merchant Street, Honolulu 96813	(808) 535-7206 ginnyp@kaplolani.org

Name	Title/Affiliation
Darren Rosario	Fire Captain/MICT/Hawaii County Fire
Address:	Phone/E-Mail
25 Aupuni Street,Room 103, Hilo,96720	(808) 938-6442 makoajames@yahoo.com

Name	Title/Affiliation
Linda Rosen, MD	Public Health-Emergency Medical Services/Department of Health
Address	Phone
1250 Punchbowl Street, Honolulu 96813	(808) 586-4433

Name	Title/Affiliation
James O. Scamahorn, MD	Kauai EMS Director

Address	Phone/E-Mail
3 3420 Kuhio Highway, Lihue 96766	(808) 942-9134 joscamahorn@yahoo.com

Name	Affiliation
Scotty Schaefer	MICT/AMR –m Maui EMS
Address	**Phone/E-Mail**
99-840 Iwaiwa St, Aiea 96701	(808)479-6471 scotty@mobeldah.net

Name	Title/Affiliation
Dan Smith, MD	ER Chief/ Queen's Medical Center
Address	**Phone/E-Mail**
1301 Punchbowl Street, Honolulu 96813	(808) 547-4408 smithdc@hawaii.rr.com

Name	Title/Affiliation
Kathleen Soukl	EMT/AMR
Address	**Phone/E-Mail**
230 Hana Hwy.,Ste 12b, Kahalui,96732	(808)205-2000 soukl911@yahoo.com

Name	Title/Affiliation
JoAnn Sterner, RN	Nurse Manager/ICU Kona Community Hospital
Address	**Phone/E-Mail**
79-1019 Haukapila St, Kealakekua 96750	(808)322-6909 jsterner@hhsc.org

Name	Title/Affiliation
Danny M. Takanishi Jr., MD, FACS	Chair of Surgery/University of Hawaii at Manoa Queen's Medical Center
Address	**Phone/E-Mail**
1356 Lusitana Street, 6th Floor, Honolulu, 96813	(808)586-2920 dtakanis@hawaii.edu

Name	Title/Affiliation
Thomas Rogers, MD, FACS	Neurosurgeon/Maui Memorial Medical Center
Address	**Phone**

39 W Kamehameha Ave, Kahului 96732	(808) 877-9078
Name	Title/Affiliation
Sharlene Tsuda	Director, Gov/Admin/ Queen's Medical Center
Address	Phone/E-Mail
1301 Punchbowl Street, Honolulu 96813	(808) 547-4988 stsuda@queens.org
Name	Title/Affiliation
Lin Watkins	MICT/AMR – Maui EMS
Address	Phone/E-Mail
230 Hana Hwy Ste 12b, Kahului 96732	(808) 576-0229 skynout@hotmail.com
Name	Title/Affiliation
Matthew Wheeler, RN	ER/RT Manager/ St. Francis Medical Center
Address	E-Mail
2226 Liliha St., Honolulu 96817	(808)547-6244 matthewww@sfhs-hi.org
Name	Title/Affiliation
Ray Vara	EVP & CEO/Hawaii Pacific Health
	Phone/E-Mail
	(808) 522-3101 rvara@straub.net
Name	Title/Affiliation
Mike Yamamoto	COO/HAA
Address	Phone/E-Mail
155Kapalulu Place #201, Honolulu 96819	(808) 833-2270 mike@hiairamb.com

Appendix C: Trauma Systems Acronym Glossary

ACLS	Advanced Cardiac Life Support
ACS-COT	American College of Surgeon Committee on Trauma
ATCN	Advanced Trauma Care for Nurses
ATLS	Advanced Trauma Life Support
BLS	Basic Life Support
CAAS	Commission for the Accreditation of Ambulance Systems
CAMTS	Commission for the Accreditation of Medical Transport Systems
CDC	Centers for Disease Control
CODES	Crash Outcomes Data Evaluation Study
CTAC	County Trauma Advisory Committee or County Trauma Audit Committee
DHHS	Department of Health and Human Services
DHS	Department of Homeland Security
DOTS	Development of Trauma Systems
EMD	Emergency Medical Dispatch
EMS	Emergency Medical System
EMT	Emergency Medical Technician
EMT-A	Emergency Medical Technician-Advanced
EMT-B	Emergency Medical Technician-Basic
ESAR-VHP	Emergency System for Advance Registration of Volunteer Health Professionals
HRSA	Health Resources and Services Administration
IPAC	Injury Prevention Advisory Committee
MAC	Medical Advisory Committee or Medical Audit Committee
MAST	Military Assistance to Safety and Transportation

MICT	Mobile Intensive Care Technician
MMRS	Metropolitan Medical Response System
MRST	Medical Response Strike Team
NHTSA	National Highway Traffic and Safety Administration
NIMS	National Integration Management System
OEMS	Office of Emergency Medical Systems
QI	Quality Improvement
PALS	Pediatric Advanced Life Support
PHTLS	Prehospital Trauma Life Support
PI	Performance Improvement
PRQ	Pre-Review Questionnaire
PSAP	Public Safety Answering Point
RAC	Regional Advisory Committee
RTAC	Regional Trauma Advisory Committee or Regional Trauma Audit Committee
SICC	System-wide Injury Control Commission
STPDA	State and Territorial Preparedness Disaster Association
STAC	State Trauma Advisory Committee
TAC	Trauma Advisory Committee
TNCC	Trauma Nurse Core Curriculum
TSC	Trauma Systems Consultation

Hawaii-Specific

BI	Big Island
HIARNG	Hawaii Army National Guard
KIPC	Keiki Injury Prevention Coalition
KMC	Kapiolani Medical Center for Women and Children
QMC	Queen’s Medical Center
TAMC	Tripler Army Medical Center

Clinical Terms

SCI	Spinal Cord Injury
TBI	Traumatic Brain Injury